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Assuring the USAF Core Missions in the Information Age

Lt Gen William J. Bender, USAF
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The United States Air Force was unquestionably the world's premier and most powerful air force in the industrial age. Our challenge and opportunity are to translate that effectiveness and capability to defend our nation into the information age. To accomplish this, we must be able to execute our five core missions of air and space superiority; intelligence, surveillance, and reconnaissance (ISR); rapid global mobility; global strike; and command and control in and through cyberspace. While our environment has changed continuously and rapidly throughout history, these enduring missions have remained our focus. We have always had to protect and

defend our capability to accomplish these missions; what has changed is our necessity to protect and assure them via the information-age domain of cyberspace.

Freedom of action in cyberspace through the application of mission assurance is a prerequisite for successful Air Force core mission execution. Obtaining and maintaining freedom of action will prevent the enemy from effectively interfering with operations. Doing so also allows the Air Force to deliver precise combat power by exploiting cyberspace's unique characteristics. Cyberspace is often poorly understood, and its unique characteristics may cause much confusion over how to best assure our core missions through cyberspace.

The Joint Staff has defined cyberspace as "a global domain within the information environment consisting of the interdependent network of information technology infrastructures and resident data, including the Internet, telecommunications networks, computer systems, and embedded processors and controllers."[1] This definition clarifies that cyberspace is much more than just traditional computer networks. While the Internet is part of cyberspace, it is not all of cyberspace. Any computer system capable of communicating with other computer systems in some way is part of cyberspace. A desktop computer, an avionics computer on an aircraft, a smart phone, an industrial controller, and the processors on a modern car are all part of cyberspace, although only some of them are routinely connected to the Internet. Most modern military equipment—from a humble truck to a B-2 bomber—has some form of processor and is thus reliant upon and a part of cyberspace.

Cyberspace is unique in that it is man-made and can be changed and modified easier than the physical domains of land, sea, air, and space. Gregory Rattray has noted that while mountains and oceans cannot be moved by combatants, in cyberspace a combatant can move or even turn off the equivalent geographic features with the flip of a switch.[2] This extreme mutability has caused some analysts to consider cyberspace to be a purely virtual domain, but this is a critical mistake.

Cyberspace is composed of information and connections in a virtual space but is grounded in the physical world.[3] According to cyberspace analyst Paul Rosenzweig, "We should never forget that though the cyber domain is an artificial one created by man, it exists only in the context of the fundamental natural domain of the world."[4] Events in the physical world affect cyberspace. If the heart of cyberspace is the connections between computing devices, then anything that impacts those devices or their connections alters cyberspace. A failed air conditioning unit at a server farm, a backhoe cutting a fiber cable, or an anchor dragging across an undersea cable can have a tremendous effect on the digital terrain. Even more important for assuring the Air Force core missions is the shared comprehension of cyberspace dependencies upon physical components.

Every one of the critical systems by which we accomplish our core missions is built upon cyberspace capabilities. Aircraft, satellites, trucks, and ICBMs all rely upon our ability to maneuver and operate within cyberspace. Some analysts have suggested that there is no such thing as maneuver in cyberspace since computers simply execute their instructions, even if those instructions include the ability to respond to stimuli. While computers do not maneuver, people do, and conflict in the cyberspace domain is fought by a melding of inflexible silicon and flexible people

telling the silicon what to do. Accordingly, conflict in the cyberspace domain remains driven by humans who make decisions and react to their adversaries in ways that would still be familiar to Clausewitz and other traditional military thinkers.[5] If we are to be successful in the cyberspace domain, we cannot rely solely upon "if-then" logic and engineering solutions. We must maneuver in and through cyberspace, but to do so effectively, we must start by developing our people.

Creating a proficient cadre of cyberspace operators is one of my top priorities. We are working hard to identify necessary skill sets and determine how to best develop the career field. However, change must go beyond cyberspace operators. Everyone in the total force must learn to think of cyberspace as a war-fighting domain, and mission assurance is not something created by technical experts alone. Every Airman who plugs an unauthorized device into a network or circumvents a security control on a maintenance loader needs to understand that he or she is creating vulnerabilities for our enemies to exploit. Our adversaries could implant weapons, resulting in our inability to accomplish our missions and, ultimately, the death of brave Americans in combat. Everything is connected, and that questionable e-mail link can unleash a weapon that crosses into mission systems. The fact that some of our systems do not use commercial operating systems such as Windows is no defense against a competent and well-resourced adversary. We must also shift our thinking away from trying to prevent every attack and towards how we are going to fight through attacks while still accomplishing our missions.

Cyberspace resilience will be the key to flying, fighting, and winning in a contested cyberspace environment. Therefore, cyberspace operators need to move beyond asking, "How can I best secure this system against attack?" to "How do I operate in a cyber-contested environment where the enemy will get through at least some of my defenses?" This requires a significant mind-set shift for military cyberspace operators, to include focusing on response capabilities such as emergency and incident-response teams and plans.[6] One of the best ways to accomplish this shift is through aggressive and thorough red teaming. A red team is a group of friendly attackers who attempt to attack systems to find their vulnerabilities and weaknesses. They use the same techniques as real-world attackers and provide an invaluable service in not only finding vulnerabilities but also giving defenders practice in how to recognize and respond to attacks to keep their systems functioning. Red teams are crucial in large-scale exercises that are unscripted and prepare defenders to deal with high-level maneuvering adversaries. Shifting to a resiliency-focused defense involves a paradigm shift that is difficult for most military personnel. Antoine Bousquet has highlighted the US military's tendency to strive for " '100% relevant content, 100% accuracy, and zero time delay' which would allow the perfect operation of a frictionless cybernetic war machine."[7] Resilience instead calls for embracing uncertainty and designing for the ability to adapt to failure and the unforeseen. The supposed revolution in military affairs that was going to dissipate the Clausewitzian "fog" through perfect information has largely been discredited, but it still echoes in US military cultural preferences to pursue perfect information. It is not just the cyberspace warriors who need to adapt; operators and support personnel who focus on the physical domains also need to practice operating effectively in an environment of constant change where not everything works as expected. Although this

training is easiest for defenders to accomplish in difficult exercise scenarios, we sometimes shy away from such scenarios due to a cultural fear of failure. When is the last time a US military unit fought an exercise "war" with none of its computers working? All too often the red team's hands are tied to preclude the fulfillment of exercise objectives. However, there has yet to be a war in which the enemy followed the script and did what was expected. Thus, we must practice as we believe we will fight in a volatile, uncertain, complex, and ambiguous (VUCA) environment. Hence, a realistic battlefield that accurately represents the future environments is essential for combatants to prepare for failure and be able to continue fighting, even if they temporarily lose some of their war-fighting systems.

Under the direction of the USAF chief of staff, I convened Task Force Cyber Secure to assure the five core missions and maintain our effectiveness in the information age. The task force teamed cyberspace operators with our operations and intelligence teammates to integrate efforts across the Air Force and focus on concrete steps to leverage opportunities while managing our risks within cyberspace. The task force helped to diagnose the problem, started an absolutely essential cross-functional dialogue, and looked hard at how to advance education and culture in cyberspace across the Air Force. In addition, the task force is setting up an enduring framework to continue moving forward that includes an Air Force chief information security officer (CISO), changes to governance and funding, and an enduring focus on mission assurance in cyberspace. We cannot afford to wait as our adversaries continue to improve their ability to hold our core missions at risk, and it will require all of us across the total force to ensure that we continue to be the world's premier air force into the information age. ✪

Notes

1. Joint Publication 3-13, *Information Operations*, 27 November 2012 (incorporating change 1, 20 November 2014), II-9, http://www.dtic.mil/doctrine/new_pubs/jp3_13.pdf.

2. Gregory J. Rattray, "An Environmental Approach to Understanding Cyberpower," in *Cyberpower and National Security*, ed. Franklin D. Kramer, Stuart H. Starr, and Larry K. Wentz (Washington, DC: Potomac Books, 2009), 256.

3. Gregory J. Rattray, *Strategic Warfare in Cyberspace* (Cambridge, MA: MIT Press, 2001), 18–19.

4. Paul Rosenzweig, *Cyber Warfare: How Conflicts in Cyberspace Are Challenging America and Changing the World* (Santa Barbara, CA: Praeger, 2013), 20.

5. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1976), 75.

6. Rattray, *Strategic Warfare in Cyberspace*, 209.

7. Antoine Bousquet, *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity* (New York: Columbia University Press, 2009), 222.

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Matrix Wings

Continuous Process Improvement an Operator Can Love

Dr. A. J. Briding, Colonel, USAF, Retired

In this fiscally-constrained environment, we need every Airman engaged in finding smarter ways to do business.

> —Gen Larry Spencer
> Former Air Force Vice-Chief of Staff

General Spencer's call to managerial arms is certainly one that our Air Force has heard before, but it is more relevant than ever. The service took this advice to heart and attempted to institutionalize Total Quality Management (TQM) in the form of Quality Air Force (QAF) over two decades ago, only to see the program wither and die after extensive effort to make it work. Yet, the necessity to get the job done smarter and more efficiently is compelling, and there should be

little argument that application of the concepts behind quality management and continuous improvement is necessary to find those smarter ways to conduct the mission and to do business. That need generated Air Force Smart Operations for the 21st Century (AFSO21), the latest comprehensive effort at finding the right approach for implementing a continuous process improvement (CPI) model intended to span "all of our environments—operational, support, and otherwise."[1] This comprehensive methodology employs concepts from "Lean, Six Sigma, Theory of Constraints, and Business Process Reengineering," and its seven-year phased approach reminds one of the extensive phased preparation involved with QAF.[2]

All of that may be well suited for support units and agencies, assuming we can find the additional time and effort to master, apply, and maintain AFSO21. However, imposing yet one more structured management methodology on operational units, even if done in phases, is unlikely to meet with any greater success than did TQM. More probably, it will simply contribute to the jaundiced view most operators have of anything related to private-sector management practices; in the words of a retired chief master sergeant, "I've been zero defected, total quality managed, micromanaged, one-minute managed, synergized, had my paradigms shifted, had my paradigms broken, and been told to decrease my habits to seven."[3] With AFSO21, that comment could be expanded to include "Leaned, Six-Sigma'd, had my theories constrained, had my processes reengineered, and been OODA-looped."

This article is not a critique of the validity of any of those methodologies because all of them bring very relevant capability to improving processes. Rather, it is a critique of returning to that managerial mind-set that helped doom QAF. Operational units could use CPI and could employ the principles in AFSO21 but preferably by employing a version that does not take time away from mission preparation/execution and that is specifically tailored for their culture. Understanding those two critical dimensions of mission orientation and culture is imperative if any CPI program is to succeed in the operational world, and it is well worth reviewing them to set the foundation for the best way to institutionalize CPI at the wing level in the Air Force.

For the foreseeable future, two challenges appear dominant: (1) continuing to meet mission requirements using fewer resources and funding and (2) adapting to meet—and preferably to stay ahead of—the constantly evolving, expanding battlespace that has taken on new dimensions as well as new, often novel, threats. Those issues demand adaptability and CPI; they are driving our military's current focus on both. When he served as chairman of the Joint Chiefs of Staff, Gen Martin Dempsey emphasized the necessity of adaptability in our leadership, pushing decision making out to the leaders who conducted operations—those individuals best positioned to evaluate the situation and determine the most effective courses of action in a volatile, uncertain, complex, and ambiguous environment.[4] On the organize, train, and equip side of the operational equation (often referred to as the "peacetime" mode), without question we must constantly look for better ways of doing each of those tasks—finding methods of implementing CPI and innovation that are part of the process, not exceptional to it, and that *do not add significantly* to the already heavy demands of mission-oriented duties. Ideally, new methods should simply reorganize those duties into a more streamlined structure.

Distinctions between the military and private sectors and between operational and support missions must be fully understood and addressed by any program that attempts to change the way our Air Force operates. If the relatively short history of TQM has shown us anything, it has demonstrated that attempts at grafting civilian or public-sector business concepts onto the military operational culture must proceed carefully, appropriately, and with full deliberation.

The Military and Continuous Process Improvement

To implement an effective version of CPI, one must assure that it is readily compatible with the culture of military operations since that is the foundation of America's military success. Operations should not be adjusted to fit a CPI mold or management culture; rather, CPI should be adapted to fit operational units. Without a fully supportive culture, CPI and other management initiatives will meet with resistance and will not endure.

The Uniqueness of the Military Culture

The essence of the American military is mission accomplishment based on protecting our nation, not generating profit for shareholders. That clear distinction between the armed forces and private sector must be kept in mind as we look to the latter for improvements in conducting military affairs. Few would deny that our leadership must concentrate on mission first, people always. The armed forces exist to defend the nation, and if the mission fails, they have failed in their obligation to the country. Yet, even when we consider America's lead in technology, we still recognize that our military personnel are the best in the world and the primary reason that the US military is so formidable (consequently, CPI and innovation have excellent potential in the services). Other countries may be able to field first-order weapons systems, but none can develop and conduct the advanced, complex concepts of joint, integrated warfare that America can. Such intricate operations depend on highly professional, intelligent, motivated, and capable Soldiers, Sailors, Airmen, and Marines, imbued with a culture of taking personal responsibility and initiative. The American military takes care of its people and enjoys a return on that investment in the form of mission accomplishment from mature leadership, improved capability, and high morale.

Those priorities—mission and people—present two criteria that are essential elements in the litmus test of any new concept recommended for use by operational military units. Will that concept serve the mission better? Will it make personnel more effective and efficient at conducting their missions, without adding to their duties (and therefore detracting from that efficiency)? Anything that ultimately takes time, effort, and resources away from mission preparation and accomplishment should be avoided.[5] That is a prime reason (but certainly not the only reason) that the Air Force's earnest attempt at implementing TQM failed. Operators are driven by mission accomplishment based on a culture of initiative and empowerment, but that culture does not readily take to accepting managerial concepts that tend to diminish military focus.

Dr. Jekyll and Mr. Hyde: The Dual Nature of the Military Mission

If a business process is to apply to the operational military, it must meet yet a third criterion. It should be able to transition effortlessly from the organize, train, and equip peacetime side of the mission to conducting military operations up to and including combat. How many businesses procure systems, train their people, and then send them out to go to the sound of gunfire? This distinction best explains the disdain our military personnel have for the concept of management—they value leadership that is operationally competent, composed, and effective under pressure rather than managers who efficiently coordinate people and other resources to attain production goals. However, this disdain fails to acknowledge the legitimate roles of good management and stewardship in the peacetime mode and in Department of Defense (DOD) support operations.

Thus, any new process or policy intended for operational military applications should meet three criteria:

1. It must improve mission capability, directly or indirectly.[6]

2. It must make personnel more effective or efficient at conducting the mission.[7]

3. It should not obstruct a smooth and seamless transition into actual military operations, including combat.

In light of these criteria, how might the Air Force optimally implement CPI in its primary operational unit—the combat wing?

Continuous Process Improvement
from a Wing-Level Operational Perspective

In contrast to the peacetime/wartime dichotomy inherent in operational DOD organizations, the support side of the department is well suited for using the processes, techniques, and tools of quality management and CPI. That suitability is more problematic for operational units for three reasons. First, the operational environment is much less stable, predictable, and controllable. Combat is an excellent example: good training, a clear mission objective, and thorough planning all help to reduce the volatility, uncertainty, complexity, and ambiguity that operators face, but few plans ever go as intended. Adaptability to the actual circumstances encountered is essential for mission success, and that is the point of General Dempsey's message.[8] Even noncombat operations such as humanitarian assistance and disaster relief are prone to depart from the planning scenario once the operation meets actual conditions. Second, the mission is the top priority—carrying out that mission once our people enter the battlespace is essential. Expense, efficiency, and standardization play only a secondary role, especially if lives are at risk. Third, the elevated risk factor, an inseparable part of actual operations, is a major differentiator between operational and support missions, and addressing operational risk takes leadership, adaptability, and innovation. Our military does so with operational risk management (ORM), but in today's operations, mission success depends on General

Dempsey's call for adaptability by leadership at all levels in the field as operations are under way, as well as in preparation of the unit leading up to taking the field. Much of that turbulence extends into peacetime operations, which are designed to directly support the operational mission and which reflect many of those operational dynamics.

The Center of Gravity for Wing Continuous Process Improvement: Key Processes

AFSO21 focuses on key processes at the executive level, but the wing's key processes—those essential to conducting its mission—are vital to implementing a formal CPI approach in operational units. Wings generally will have a significant number of these processes, including launching aircraft and delivering bombs on target, maintaining base facilities, keeping the base secure, and providing full personnel support services.[9] Such procedures deliver or directly contribute to mission results and generally are complete within themselves, starting and finishing within the wing. They almost always span multiple squadrons. Launching aircraft calls for runways, control facilities, maintenance, and mission-ready crews and aircraft; all of this and more would be part of this key process. Dropping bombs on target demands flight planning, intelligence, communications, trained aircrews, crew-rest facilities, logistics support, and so forth. The hierarchical structure inherent in a wing, illustrated in the figure below, runs counter to the grain of those processes. They are horizontal, so a hierarchical structure breaks them up into smaller, often uncoordinated parcels within the entire process—a fundamental shortcoming of hierarchical structures. That is a prime reason for designing matrix organizations: to overcome poor horizontal communication and teamwork as well as other hierarchical inefficiencies that all too often greatly reduce effectiveness, efficiency, and flexibility of procedures which span the enterprise. An environment conducive to CPI and innovation must start with a structure that supports them.
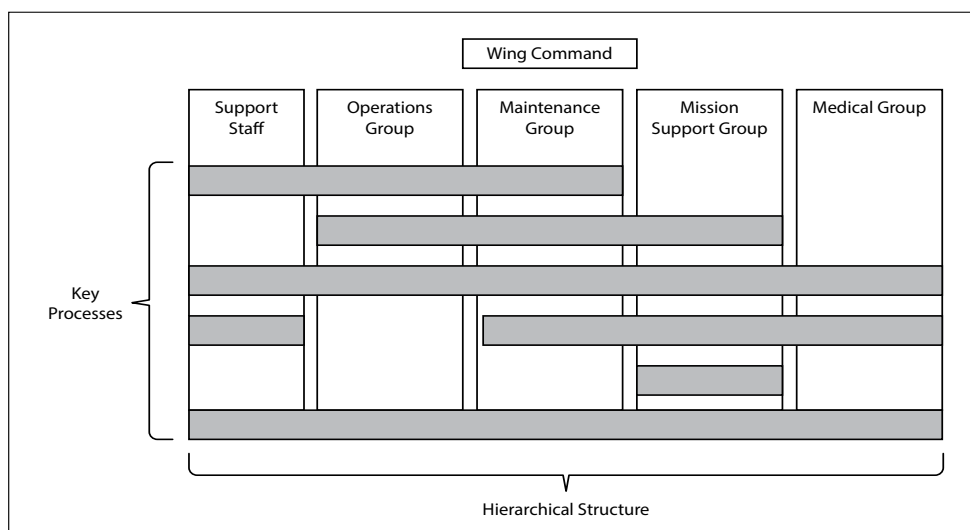
Figure. Common Air Force hierarchical wing structure and key processes

Redesigning the Wing as a Matrix Organization

If a wing commander were to visualize the ideal structure for managing his or her key processes, it would likely have the traits of keeping a clear mission focus; bringing together experts from all the functions of which the key process is comprised and having them work as a team; and keeping supervisors and commanders in a position to monitor the performance of their personnel and the outcomes of the process. All of the above could be part of a matrix approach to accomplishing key processes—one applicable in both peacetime and operational modes without violating any of the concepts of military leadership and chain of command. A matrix approach also dovetails nicely into the AFSO21 concept of organizing for process improvement.[10] Our Air Force culture has a strong advantage in conducting matrix operations as well. Mission focus; the core values of service before self and excellence; and the emphasis on empowerment, adaptability, innovation, and diversity establish the right environment in which a matrix approach can thrive—an environment that private-sector matrix organizations strive for but often fail to attain.[11]

Matrix structures have been around for over 40 years, allowing ample time to better understand and refine their application. Those lessons learned can be grouped into three domains: structure, processes, and psychology or culture.[12] Many private-sector corporations have found that if they implement the elements recommended, then matrix organizations give them a significant competitive edge in flexibility and innovation.[13]

Organizational culture, an essential element of the psychology domain, is considered the critical factor for success. "The key organizational task is not to design the most elegant structure but to capture individual capabilities and motivate the entire organization to respond cooperatively to a complicated and dynamic environment."[14] That quotation from a *Harvard Business Review* article could have come from the Air Force chief of staff. We have the psychology in place: mission focus, teamwork, service, empowerment, and innovation. In the private sector, building the necessary culture is one of the most difficult challenges for implementing successful matrix organizations.[15]

Another advantage the Air Force has over the private sector is that key processes are less likely to come and go due to quickly changing market pressures to which a private business must respond. Thus, the service provides stability that is an advantage for matrix organizations. The ways and means may change, but the ends of the key process are not as susceptible to external dynamics.

Cross-Functional Operations (Matrix) Teams

By the time the pilot climbs into the cockpit or the patrol squad leaves the security of the base, many moving parts have to fall into place. Training, planning, equipping, intelligence support, maintenance, logistics—all of those and more must contribute essential elements to the mission. When an aircraft is not ready to launch, is that status a scheduling, maintenance, or logistics problem? When representatives from all of those functions are part of the process management, determining the root cause of a problem becomes easier. Consequently, the team can more readily make corrections to fix issues, remove bottlenecks and smooth the process flow,

and envision process improvements and innovations that deliver their product more reliably and efficiently. To do so, its members need only demonstrate professional competence, mission focus, a can-do attitude, and common sense. No expertise in process improvement methodologies, analytical processes, or other CPI tools and techniques are necessary to create a smart, productive team that can deliver CPI. This arrangement into matrix or operations teams also supplies the team with dynamics and insights that best enable innovation. Putting together experts with a vested interest in the process will cause ideas to start flowing naturally, especially if leadership encourages innovation. If the goal of AFSO21 is to maximize value, eliminate waste, and implement CPI, then the best approach toward that end resides in operations teams.[16]

The simplicity of this concept is its prime virtue, raising the question of why cross-functional teams do not run the key processes in our normal operations. In addition to the almost inevitable resistance to change, one of the points of pushback is that members of the teams have two bosses: the team leader and their functional commander. At first glimpse, this situation would seem to violate the military's essential unity of command via the normal chain of command; it would also seem to remove the functional commander from a primary to a secondary role of oversight of the process components. For some military leaders, this transition strikes them as anathema, but normal military authority and responsibility can still be maintained.

Working Out the Details

On face value, using a matrix approach in Air Force wings has excellent potential. The problem involves converting that potential into improved mission execution and support—tailoring the operations teams and key-process oversight mechanisms to meet each wing's specific procedures. A bottom-up, not a top-down, design and implementation would be the best approach. Top-down guidance from higher headquarters would prove useful for framing the program to include expectations, but the actual matrix structure and corresponding networks should be set up by each wing and its operations teams. As suggested by the title of Christopher Bartlett and Sumantra Ghoshal's *Harvard Business Review* article "Matrix Management: Not a Structure, a Frame of Mind," successful matrix organizations are less about using a specific framework and more about applying the right perspective.[17] Operations teams will also naturally tend to self-improve and evolve in response to changing operational conditions and experience, assuming the team has competent leadership and is properly empowered and motivated to manage the process.

Implementing operations teams would be relatively simple. First, each wing would need to identify its key processes (a laundry list of normal key processes put together by numbered air force staffs for their wings could act as a starting point), breaking down the major ones into manageable component procedures if necessary. For example, wings with multiple flying missions might prefer to separate key processes by airframe. The group commanders should then come to a consensus on selecting process owners, letting them choose the process manager and request

functional experts from the squadrons that have significant roles in each process. It would be up to the process owners (e.g., group or squadron commanders, deputy commanders, operations officers) to set the operational parameters, metrics, and other guidance for the team but emphasize the necessary empowerment to let the team run the process as it sees fit. Innovation should be encouraged, and recommendations for innovative process improvements would go through the process owner for approval. A senior leader council could also assess more comprehensive recommendations, including the use of AFSO21 procedures. The process owner would have the responsibility for ensuring that regulations, policy, and other applicable guidance are followed and that fresh ideas are properly vetted at the right levels for approval before implementation.

Once these teams became operational, the normal routine would experience very little disturbance. No CPI-specific training would be necessary although a familiarization course introducing them to the AFSO21 tools and techniques would prove useful. As the teams became more effective, they could select specific tools to improve their process management (having an AFSO21 expert at the wing to train and coach them would enable that option), but learning how to apply AFSO21 tools should be pull, not push, training. Functional experts would still perform their standard duties, and commanders would maintain control over their functional areas; group and squadron commanders would still have oversight and control of their people and process outputs. The main difference would be that the team structure would facilitate teamwork daily, including direct coordination between the essential functions in the process.

The Crux of Operations Teams: Leadership and Decision Making

The test of effective leadership in a matrix organization is the willingness to let the teams' leaders take charge of their processes and to give functional representatives the latitude to make decisions within their area of expertise. Because such willingness is the essence of empowerment, matrix teams offer a concrete path to truly empower Airmen in the accomplishment of their duties, enabling and focusing the military's best resource: its people. As with any scheme of empowerment, the process owner should confer decision-making authority but with clear decision-making boundaries that allow subordinates to direct operations within those bounds. This scenario is nothing new—in essence, it amounts to applying ORM program concepts to process management. Senior supervisors and commanders should collectively set the goals, metrics, and other parameters that define those boundaries. The oversight incumbent upon the functionally responsible commander keeps the chain of command in the loop and does not abrogate his or her ability to intercede in the decision-making process when warranted. As with ORM, a framework for escalating decision making should be put in place. That framework could be worked out within the vertical supervisory chain for each functional area representative, based on the nature of the decision to be made and on each supervisor's and commander's tolerance level and confidence in the functional representative. However, basic process-improvement decisions should be left to the team, and the urge to run

functional decisions up the chain should be discouraged. Policy decisions would be more appropriate for escalation to the proper level.

Ruth Malloy lists four essential skills for successful leadership of a matrix team: influence, self-awareness, empathy, and conflict management.[18] Concerning influence, the essence of matrix teams is collaboration. When appropriate, decisions could be made collectively, but the team leader will need to recognize when he or she must make the decision unilaterally. Military leadership training emphasizes self-awareness, so the ability to adapt leadership styles and decision making to suit the context should be expected in the team leaders. Empathy and emotional intelligence should also come without prompting since they also are considered useful traits in military leadership. Conflict management is less of a concern in the military than in the private sector due to the clear lines of authority and responsibility under which military units, including operations teams, operate.

Depending on the key process, a junior-officer or field-grade-officer level would be the best one for team leadership (i.e., process manager). His or her influence would be established by rank, and as with all military leadership, should be earned by applying professional competence and good leadership ability. Networking, building good two-way communications channels horizontally and vertically, influencing, facilitating, and coaching: these matrix organization skills are desirable characteristics of military leadership in any context.[19]

Obtaining Organizational Buy-In

As with any significant change, one must overcome inherent organizational resistance. The cultural attributes normal to military organizations could be enablers in a transition to matrix teams, especially if leadership emphasized the mission focus, teamwork, and empowerment benefits while pointing out that CPI-specific training would not be necessary. Perhaps the toughest sell would be to senior leaders, who would feel that they were giving up some of their command authority. Building the right combination of horizontal and vertical control over the operations teams, as discussed previously, should allay that concern, as would the understanding that the chain of command still maintained operational responsibility for functional performance. The operations team concept would also work under deployed conditions but with reinforced emphasis on responsibilities of the functional chain of command. As with any organizational change, leadership at all levels would have to support it fully. Senior-level endorsement could be reinforced in periodic (e.g., monthly or quarterly) key-process performance briefings by the teams to the wing and group commanders. Senior-level briefings would also offer a good cross-check that the teams are concentrating on the larger mission, staying within bounds, and not losing themselves in internal preoccupation with their processes (i.e., "navel gazing").[20]

As is always the case with military units, leadership turnover could be detrimental to the continuity of the program. The wing commander must fully sponsor it and ensure that his or her replacement is fully briefed on the program's implementation. Providing the rationale behind the matrix wing and the way it works should suffice to convince the new commander to adopt ownership and avoid disruption, especially because the matrix concept would be fairly transparent in daily wing op-

erations and would be responsive to other initiatives the wing commander might want to pursue. However, if the matrix wing were institutionalized at the numbered air force level, then new leadership could easily be in-briefed on the program, with the implicit expectation that this program is the new normal across the command.

Benefits

The benefits of implementing a matrix structure for managing key processes, if properly accomplished, will significantly outweigh negative offsets.

Relative Ease of Implementation

In a normal wing, key processes could be identified, operations teams formed, and oversight mechanisms put in place in only a few months. No prerequisite training in process-management methodologies would be required. Comparison of the proposed structure to the seven-year AFSO21 implementation plan makes obvious the benefit of keeping personnel focused on the mission and not on auxiliary training.

Strong Alignment with Critical Success Factors of AFSO21

The AFSO21 playbook specifies three critical success factors: (1) "Results oriented," (2) "Total Air Force involvement" that changes the mind-set "to continually [seek] the best way [to] accomplish daily work," and (3) "Sustained and deliberate application . . . ultimately, embedded in our culture."[21] Implementing and institutionalizing operations teams for key processes constitute a simple and elegant improvement in all three areas.

Total Process Management

As the teams get to know each other and see how their processes work across functional lines from start to finish, the insights from that holistic analysis alone will normally lead to immediate process improvements. After the complete process is better understood, commonsense improvements that identify suboptimization, eliminate unnecessary or duplicate effort, and better manage process flow will become evident.

Mission Focus

Military leaders know that for better morale and performance, everyone in the unit should understand how his or her duties carry out or support the mission. Key process members should be able to make that association clearly and see the results of their work reflected in better mission accomplishment.

Empowerment, Teamwork, and Motivation

Seeing linkage to the mission is an excellent motivator, and that motivation is increased when empowerment and teamwork allow team members to make a difference

in that mission. As the teams start to see improvements from their effort, that success will reinforce the value of their empowerment and teamwork.

Better Responsiveness

The responsiveness and greater adaptability of matrix teams have been well documented.[22] These qualities will serve the Air Force well because its key processes are affected negatively by reduced manpower and budgets, as well as positively by the potential of new processes and technologies. For instance, technology as simple and ubiquitous as social media can be more quickly assessed for utility and custom tailored to a process. Further, more complex technologies and advances in methodologies can be better evaluated for applicability and impact across the key process, reducing the risk of suboptimal implementation of technology that may improve a component function of the process but at little or no improvement to the process overall. This tendency for suboptimized point solutions is a common manifestation of hierarchical organizations. Part of the oversight mechanism set up by the wing should be the ability to accelerate recommendations for significant new policy and procedures that would require regulatory, policy, or procedural changes, using AFSO21 procedures.

More Leadership Opportunity

The officer put into a team-leader position will soon find that his or her collaborative leadership skills across multiple disciplines will be put to the test and refined much more so than would be the case by overseeing a functional group. Consequently, that officer will gain a better understanding of the other disciplines.

Innovation and Initiative

A companion concept to CPI is innovation. Both deliver better results—CPI in an incremental manner, innovation in a more transformational way. The Air Force thrives on high-technology innovation, but process innovation is often overlooked, and the hierarchical structure makes comprehensive process innovation more difficult because of fiefdoms, stovepiping, and organizational inertia. Operations teams would help implement an innovation-friendly environment for the key processes where new ideas and initiative should thrive. We do not fully tap the potential of our personnel by urging them to use the suggestion box; rather, we should encourage and empower them to directly improve their key processes as part of an operations team.

Part of that team environment is the diversity of thought brought to the team by the different functional experts, again setting up the team for innovative solutions. Gen Mark A. Welsh III, the former Air Force chief of staff, placed major emphasis on diversity as a means of implementing innovation.[23]

The Matrix Wing in Practice

The matrix wing concept was applied to the 374th Airlift Wing at Yokota Air Base, Japan, in 1997–98. In addition to conducting its operational missions, the wing was

also fully in charge of maintaining the base and all of its support functions for 40 tenant organizations and the base population of 12,300 people. The wing put 150 personnel into operations teams for its 26 key processes and set up an operations council headed by the vice-wing and group commanders. The council provided oversight and support across the teams, ensuring strategic alignment with wing and higher headquarters goals/policies and determining optimal funding distribution and resource allocation among the key processes. Commanders retained functional oversight and management while the operations teams were given process management leadership. After only six months, significant process improvements generated by the operations teams became evident.

The greatest gains occurred in functions that spanned the logistics group, in which the operations teams used the action workout procedure to determine process improvements. Because of the scope of the results, the DOD's director of quality management sent a certified public accountant to Yokota to verify the claims. The CPA validated that improving the overhaul process for 40,000-pound aircraft cargo loaders "resulted in saving $93,509 per loader, while reducing the overhaul cycle time from 15 to 2 months" and that restructuring repair processes for C-130 aircraft engines reduced "repair cycle time from 66 to 19 days, and [produced] cost savings of $171,000 per engine."[24]

As another example, key process 4.4 promoted community relations, an extremely consequential focus area since Yokota was tightly surrounded by 11 townships and prefectures, most of which were antagonistic to the presence of the base. The operations team implemented several novel solutions: establishing a vice-mayors council that would meet quarterly to inform key Japanese officials of the wing's mission, listen to their concerns, and find ways to partner with them in common areas such as firefighting and managing quiet hours; opening the base to a historical walking tour that let the local community see many of the Japanese monuments on the base; organizing joint concerts between Japanese military bands and the Air Force Band of the Pacific; and coordinating a weekly informational broadcast with an estimated listening audience of well over 10,000 Japanese across the Tokyo area, hosted by the wing commander to inform the audience of the services offered by Yokota. These public relations initiatives brought together functions from all four groups and the wing staff agencies. Because of these efforts, several of the most adversarial mayors became supporters in that time frame.

Feedback from the operations teams was very positive, and several of the recommendations in this article are based on lessons learned from that prototype implementation. These and other process improvements, combined with implementation of the matrix wing concept, led to the 374th Airlift Wing receiving the President's Quality Improvement Award—one of eight DOD agencies to receive it in 1998.

Conclusion

The thrust for improving how our military conducts its business is inescapable; it is the mandate that changing conditions and diminishing resources impose on any organization that seeks to stay relevant and productive. For the military, productivity

is the ability to conduct the mission, and until the Air Force successfully institutionalizes CPI and innovation in operational units, the shaft of the spear may remain strong, but the point can become brittle. The key to implementing continuous improvement in Air Force wings entails removing restraints endemic in the hierarchical structure and empowering operations teams to run their key processes, all the while maintaining focus on the mission and teamwork rather than on management methodologies. The matrix wing concept leverages the inherent qualities of our military culture, removes obstacles to effectiveness imposed by a hierarchical structure, and bestows true leadership and empowerment on the teams. With minimal cost in time, effort, and funding, it is a solution ready to meet current and future challenges. ✪

Notes

1. Department of the Air Force, *Air Force Smart Operations for the 21st Century (AFSO21) Playbook*, version 2.1 (Washington, DC: Department of the Air Force, May 2008), A-1 ("Section One: Executive Summary"), http://www.au.af.mil/au/awc/awcgate/af/afd-090327-040_afso21-playbook.pdf.

2. Ibid.

3. Lt Col Graham W. "Gray" Rinehart, USAF, Retired, "How the Air Force Embraced 'Partial Quality' (and Avoiding Similar Mistakes in New Endeavors)," *Air and Space Power Journal* 20, no. 4 (Winter 2006): 35, http://www.airpower.maxwell.af.mil/airchronicles/apj/apj06/win06/win06.pdf.

4. Gen Martin E. Dempsey, "America's Military—A Profession of Arms," white paper (Washington, DC: Department of Defense, [2012]), http://www.jcs.mil/Portals/36/Documents/Publications/aprofessionofarms.pdf.

5. Periodic training in social elements that affect unit effectiveness (e.g., sexual harassment and assault, workplace harassment and discrimination, and drug and alcohol abuse) should be considered as a requirement that directly supports the mission by maintaining good order and discipline.

6. Indirect support would include taking care of our people, budgeting, managing resources, and other essential elements of our American concept of military operations.

7. Mission accomplishment would include all of the core functional areas represented by specialty codes.

8. Dempsey, "America's Military."

9. When the 374th Airlift Wing at Yokota Air Base, Japan, implemented a matrix wing structure, the executive committee identified 26 key processes that fell under the following key result areas: 1.0 Mission Ready Forces and Equipment, 2.0 Base Operating Support, 3.0 Quality of Life, and 4.0 Host Nation Military and Local Community Relations.

10. Department of the Air Force, *Air Force Smart Operations*.

11. Christopher A. Bartlett and Sumantra Ghoshal, "Matrix Management: Not a Structure, a Frame of Mind," *Harvard Business Review*, July–August 1990, https://hbr.org/1990/07/matrix-management-not-a-structure-a-frame-of-mind; Ruth Malloy, "Managing Effectively in a Matrix," *Harvard Business Review*, 10 August 2012, https://hbr.org/2012/08/become-a-stronger-matrix-leade/; and Gill Corkindale, "Surviving Matrix Management," *Harvard Business Review*, 19 June 2008, https://hbr.org/2008/06/surviving-matrix-management.

12. Bartlett and Ghoshal, "Matrix Management."

13. Malloy, "Managing Effectively."

14. Bartlett and Ghoshal, "Matrix Management."

15. Ibid.

16. Department of the Air Force, *Air Force Smart Operations*.

17. Bartlett and Ghoshal, "Matrix Management."

18. Malloy, "Managing Effectively."

19. Corkindale, "Surviving Matrix Management."

20. Stanley M. Davis and Paul R. Lawrence, "Problems of Matrix Organizations," *Harvard Business Review*, May 1978, https://hbr.org/1978/05/problems-of-matrix-organizations.

21. Department of the Air Force, *Air Force Smart Operations*, A-1–A-2 (see sec. 2.2.)

22. Davis and Lawrence, "Problems of Matrix Organizations."

23. Gen Mark A. Welsh, "Perspective," US Air Force, accessed 12 May 2016, http://www.af.mil/diversity.aspx.

24. Director Anne O'Connor (DOD Quality Management Office), official correspondence with the wing commander, 2001.

Dr. A. J. Briding, Colonel, USAF, Retired

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Strategic Flexibility to Deter in the Asia-Pacific

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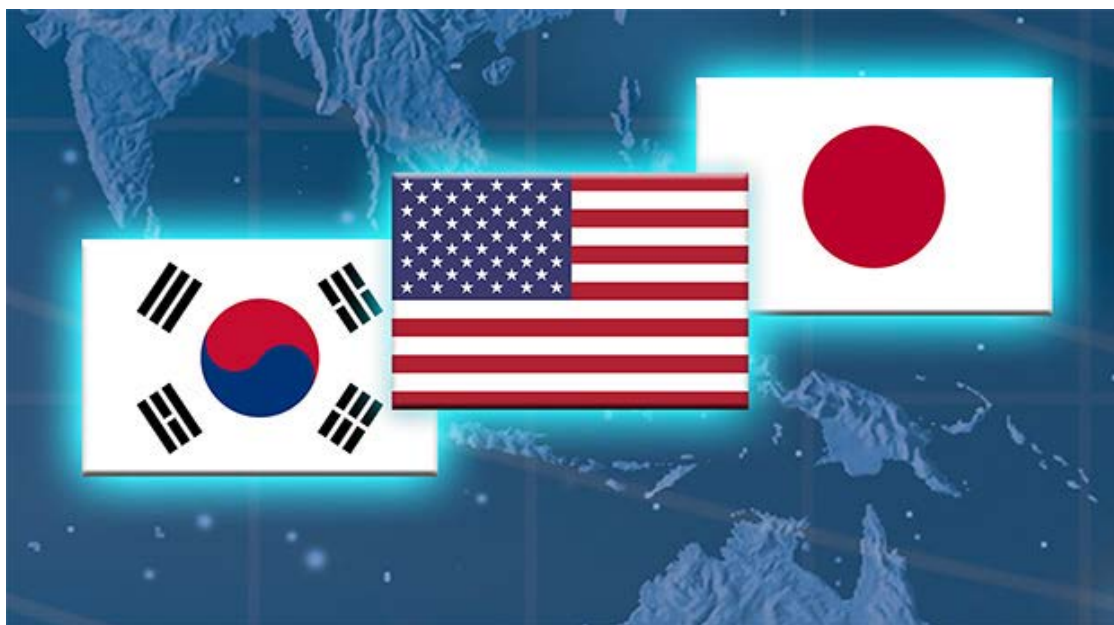
The recent military resurgence of both China and Russia, along with the United States' so-called rebalance to the Asia-Pacific and declining military budgets, suggests the need and opportunity to reevaluate US military policy for the region. Increased air and maritime shows of force, China's declaration of an unusually expansive air defense identification zone (ADIZ) in November 2013, its continued improvements to island infrastructure in the South China Sea over the past year, and Russia's illegal annexation of Crimea, all point toward active and intentional policies to project regional strength by the two nations despite US political and military efforts to deter them.[1] With the United States focused on wars in Iraq

and Afghanistan over the past two decades and in Syria today, China now presses "its territorial claims more aggressively, [with] Russia interfering more brazenly."[2] In today's volatile security environment—particularly in the Asia-Pacific—the United States should continue to move away from pre–Cold War models of bilateral defense agreements supported by relatively large footprints of permanent forward military presence in favor of an expeditionary defense posture featuring "strategic flexibility." Such a posture would enhance regional deterrence by reducing predictability and providing political leaders a greater range of responsive options.[3] In-theater military capabilities of sufficient quantity, quality, responsiveness, and survivability—free from requirements to respond to a specific threat from a specific location—comprise the key elements of a proposed US defense posture of strategic flexibility. To help achieve this posture in a period of budget austerity, the United States should pursue a trilateral defense relationship with its two most capable military allies in the region—Japan and the Republic of Korea (ROK)—and consider modifications in the regional force structure that offer persistent presence but without precondition.

Flexible Deterrence for Today: Dissuasion

"Deterrence" in this case is slightly nuanced from the purely deterministic version established by Thomas Schelling in his seminal work, *Arms and Influence*.[4] He posited that deterrence—a posture to prevent an adversary action—acted as the more "defensive" counterpart to "compellence," a posture to reverse an action already taken. Both of these postures reside beneath the larger concept of "coercion" (i.e., leveraging an actor psychologically to pursue a course of action he would not otherwise choose, backed by the threat or use of force). This form of deterrence follows an "if-then" deterministic logic; if an adversary elects to embark upon a specific action, then a specific result will occur. This posture, while often effective, actually limits response options for policy makers, essentially requiring the establishment of a "red line" that, if crossed, will necessitate follow-through on the threat of force to preserve overall credibility. Deterrence here refers more to the deterrent effect of a range of policy options supported by the breadth of the nation's instruments of power and "unguided by an overt deterrence policy"; some define this deterrent effect as dissuasion, as does this article, although in the Department of Defense's (DOD) joint doctrine, this concept is closest to strategic deterrence.[5] This more associative form of policy "suggests a response may follow to varying degree . . . [and follows an] 'if . . . maybe' form of flexible policy. . . . We associate by movement, posture, procurement, or inference that if another nation takes any unfavorable action, then we might take some *unspecified* action in response. . . . We set our policy, go about our business, and retain the flexibility to act in response to the choices of the other party" (emphasis added).[6]

This more flexible and associative form of deterrence—or dissuasion—also encompasses the positive policy aspect of assurance. In addition to the deterrent effect on an adversary's action, dissuasion can "share a corresponding positive policy purpose . . . attracting and assuring allies against the ranks of the potential aggressor." This

article views dissuasion as encompassing both a deterrent and an assuring effect, and as "these two objectives of policy work together toward our national security," they can yield tremendous effects in the Asia-Pacific, especially when synchronized with key allies like Japan and the ROK.[7]

Assuring allies has risen in importance for the United States of late because partners and potential adversaries increasingly believe that America may be unwilling—or perhaps economically unable—to engage in extended military operations. The highly publicized sequestration fights in the US Congress, President Obama's decision not to act following Syria's crossing of his chemical-weapons-use red line, a perceived weak response to the annexation of Ukrainian sovereign territory by Russian forces, and the rapid rise and expansion of the Islamic State have all contributed to this belief. "These [perceived] retreats plant a nagging suspicion among friends and foes that on the big day America simply might not turn up."[8] Consequently, President Obama succeeded in securing $1 billion from Congress in 2014 under the European Reassurance Initiative, a mechanism to reassure European and NATO allies through increased exercise scope and scale, as well as joint military presence. This funding continues into the next fiscal year at a minimum, but it does not apply to the Asia-Pacific, where a resurgent and assertive China projects unclear intentions, the North Korean Kim regime remains ever-bellicose, and Russia's eastern front continues to display elevated military activity. The fact that "in 2013 Asia outspent Europe on arms for the first time—a sign that countries calculate that they will have to stand up for themselves" and are no longer assured that the United States will come to their aid—suggests that America may have misprioritized its reassurance funding and unintentionally added to the heightened nervousness of the Asia-Pacific region.[9]

However, by adopting a policy of strategic flexibility, based on a theoretical foundation of dissuasion, the United States can both deter its adversaries and assure its allies in the Asia-Pacific. Furthermore, when that policy is coupled to a strong US-Japan-ROK defense agreement and a force structure less tied to precise responses to specific threats, the dissuasive effects of strategic flexibility only increase.

A Resurgent China

Since the founding of the People's Republic of China (PRC) on 1 October 1949, China's national security strategy and corresponding willingness to use force have been a function of its perceived economic and military strength relative to that of the United States and the [former] Soviet Union / Russia. In its first three decades—while its relative economic and military strength trailed significantly that of the United States and the Union of Soviet Socialist Republics (USSR)—the PRC pursued and executed a policy of "active defense" under Chairman Mao.[10] Deterring invasion represented the PRC's primary goal, but China also displayed a willingness to use force to defend its territory and sovereignty from encroaching powers, thus demonstrating credibility and resolve. During this period, the PRC also strictly limited its use of force in order to minimize the likelihood of inadvertent and expensive escalation.[11]

After the death of Mao Zedong in 1976, Deng Xiaoping assumed power in the PRC, beginning three decades of economic reform and growth by leveraging urbanization, flexible pricing, and foreign investment relatively free of bureaucratic regulations within special economic zones. Along with the collapse of the Soviet Union in 1991, this burgeoning wealth enabled China to invest more in its military, increasing spending annually by at least 10 percent since 1989.[12] Despite this growth, China still lagged the United States in both economic and military power, prompting Deng to adopt "韜光養晦 (tāo-guāng-yāng-huì)" as the PRC's policy.[13] This Chinese idiom translates to "conceal one's strengths and bide one's time"—using military force to deter or as a last resort. The PRC began to use force to obtain natural resources and secure sea lines of communications in the South and East China Seas.[14]

Since 2000 China's economic rise has continued. In 1990 the PRC's nominal gross domestic product (GDP) was tenth in the world. By 2000 it ranked sixth, and by 2009 the PRC's GDP trailed only that of the United States.[15] GDP per capita continues to grow stably, creating an attractive and increasingly indispensable PRC market for its regional neighbors.[16] Trends like these have allowed the PRC today to assert itself regionally, grow closer to attaining regional hegemony, and possibly overcome its "century of humiliation . . . with a focus on regional dominance."[17] Although some individuals cite China's very recent economic slowdown as cause for optimism, the PRC still increased its military spending 7.6 percent in 2016.[18] This figure represented the lowest increase in Chinese military spending in six years and the first single-digit increase since 2010, but it follows over two decades of double-digit increases and occurs simultaneously with reductions in defense spending across the Western world. A modicum of optimism may be present in these figures, but the momentum behind Chinese military spending has far from flagged.

Today, China pursues its maritime and territorial goals in the East and South China Seas by claiming "protection of their maritime rights," and as its military capabilities increase, the PRC will coerce nations like Japan and the ROK with threats of military force to influence or resolve disputes in its favor.[19] Some observers contend that China intends to carry out a "short, sharp war" with Japan to seize the Senkaku (known as the Diaoyu in China) Islands.[20] Japan sees China's reemergence in the Asia-Pacific as a direct threat both to its claim to the Senkakus and its overall security.[21] This perception increases the possibility of regional armed conflict that some people consider inevitable and led Japan to "consider revising its pacifist constitution."[22] China's establishment of the controversial ADIZ in the East China Sea continues the trend, and its investment in the construction of seven new islands within the South China Sea adds to the tension. Supposedly crafted to improve "the living and working conditions of those stationed on the outposts" near the contested Spratly Islands, the new islands comprise over 3,200 new acres of power projection capability for China, encompassing state-of-the-art ports, airfields, and even basketball and tennis courts.[23] Multiple encroachments by China's Coast Guard into Japanese waters continue unabated, the PRC seeming intent on controlling its surrounding waters and limiting US Navy (USN) dominance in both the Pacific and Indian Oceans.[24] Even though the United States continues to pressure China diplomatically and militarily to "resolve maritime disputes . . . based on international legal principles" and an ASEAN (Association of Southeast Asian Nations) code of conduct,

China remains content to operate outside established international protocols, inter-acting with individual countries bilaterally to realize its aims whenever possible.[25]

The PRC's bilateral approach also undermines the United States' bilateral alliances in the region. For example, the PRC opposed Japan's announcement of "collective self-defense" in a joint statement with the ROK in July 2014, and in February 2015 the PRC advised the ROK against the deployment of US-sponsored Terminal High Altitude Area Defense missile capabilities in Korea. As China's economic and military might continues to grow, so does its ability to actively influence the internal affairs of its regional neighbors. As the ROK and the Republic of China find themselves increasingly unable to resist China's immediate economic and military influence, other US partners in the Asia-Pacific region may also yield to China's growing hegemony.[26] To avoid a domino theory of a different kind, the United States must rethink its bilateral alliances in the Asia-Pacific region.

Rethinking Asia-Pacific Bilateral Relationships

Article V of the US-Japan Treaty, signed in January 1960, represents a Cold War–era pact for both nations to "support each other if attacked."[27] Today, Japan remains the primary beneficiary of this dated agreement, which originally focused on counter-balancing the Soviet Union.[28] However, with China's reemergence and North Korea's unpredictability, the US-Japan relationship has found renewed relevance in shaping the Asia-Pacific environment.[29] Although the Japanese interpretation of collective self-defense is a welcome enabler to increased bilateral interoperability and engage-ment, Japan must exercise caution to avoid inflaming Sino-Japanese relations. Despite subtle but direct appeals to Japanese leaders to tone down their rhetoric and pro-vocative actions toward China, US leadership has experienced only mild success in this area. Prime Minister Shinzo Abe's visit to the controversial Yasukuni Shrine, despite US vice president Joe Biden's tactful suggestion to demur, offers a noteworthy example.[30] Understandably, the United States avoids criticizing Japanese leaders, believing that China will continue its intimidation tactics if there is "any hint of daylight between [the] Americans and Japanese."[31] But any unilateral Japanese mili-tary response to Chinese provocation will put US credibility in jeopardy. Should the United States fail to support Japan, international trust in the reliability of American promises and power will erode further, motivating other nations to "bandwagon with China and accommodate its interests."[32] Furthermore, a swift US military re-sponse in the East or South China Sea, in accordance with its mutual defense treaty with Japan, places America at an inherent disadvantage. The People's Liberation Army (PLA) Navy would enjoy "the luxury of concentrating all of its forces and ef-fort" on the confrontation, but the United States would employ only "a fraction" of its armed forces, given other commitments around the globe; "it stands to reason that PLA forces could be strongest where it counts [in the East and South China Seas], even if they remain weaker overall" when compared to the entirety of Ameri-can military strength.[33] Thus, the dated US-Japan defense treaty actually limits rather than expands mutually beneficial military response options—it must be re-written as agreed to during the October 2013 Security Consultative Committee

meeting.[34] This important relationship can endure without an American blank check to fund it and can evolve to support a US policy of Asia-Pacific strategic flexibility founded in dissuasion.

The US-ROK alliance, dating to the 1953 Korean Armistice, would also benefit from a thoughtful revision. The same logic applies to a unilateral action by China, North Korea, or the ROK potentially forcing the United States into a high-stakes confrontation to preserve its credibility—a confrontation that it might otherwise choose to avoid. In this case, though, the ROK's economic self-sufficiency may be the key to uncouple America from its confining treaty with Seoul. The ROK and the United States have already agreed upon ensuring continued ROK economic growth as a means of funding the military improvements necessary to assume a greater role in its own defense. In an April 2014 joint ROK-US news conference, President Park Geun-hye called the ROK-US Free Trade Agreement, along with the mutual defense treaty, the "two major linchpins" of the alliance and the keys to the ROK's entry into the Trans-Pacific Partnership (TPP).[35] TPP membership not only would increase the ROK's financial opportunities but also "could increase cooperation in the Asia-Pacific region."[36] The potential financial gains resulting from ROK participation in the TPP would provide increased funds to absorb more of that country's defense burden—a US request—specifically in the areas of air and naval war-fighting capabilities. By bolstering the ROK's economic growth as a way of funding required military improvements, America may create the negotiating space necessary to reshape its alliance with the ROK to achieve true strategic flexibility.

A US-Japan-ROK Trilateral Partnership

In line with the US national security strategy, it is time for the United States to diversify its "security relationships in Asia as well as [its] defense posture and presence" in the region.[37] This statement suggests that the latitude to explore mutually beneficial defense solutions for the region must extend beyond the current bilateral relationships that both define and confine US response options in the Asia-Pacific.

Given the deep and confrontational shared history between Japan and Korea, some commentators would contend that a trilateral relationship between these two nations and the United States is impossible. However, despite centuries-old tensions, founded in Japanese colonial rule and military occupation of Korea from 1910 to 1945, as well as contemporary disputes over territorial claims, both nations have shown indications for closer political and military cooperation, including the recent "comfort women" agreement between Prime Minister Abe and President Park.[38] This progress is critical since "the failure of Korea and Japan to deal with their past imperils not only their own security but [also] America's."[39] Numerous issues remain obstacles to compromise, but the Dokdo/Takeshima Islands dispute remains the oldest and one of the most contentious, involving terrain that "Koreans view as a symbol of liberation from Japanese colonial rule."[40] This dispute must be resolved, for if left unattended, "it will affect bilateral relations, including security cooperation" to counterbalance China and an unstable North Korea.[41] The United States may be in the best position to facilitate an acceptable resolution, given its

deep influence with both nations. Selling a trilateral approach to regional security, however, calls for "a new kind of statesmanship . . . to heal such entrenched divisions," starting with US presidential leadership to "encourage such bridge-building" by bringing Prime Minister Abe and President Park together for meaningful talks.[42] Admittedly, this endeavor is daunting because "strategic and military cooperation between the two neighbors is almost nonexistent, and what little there is usually takes place out of public sight."[43]

Brad Glosserman, executive director of the Honolulu-based Pacific Forum Center for Strategic and International Studies, offers some recommendations to consider. In addition to a "'joint [Korea-Japan] declaration' . . . [of] renewed ties," he recommends a pledge to maintain a peaceful neighborhood and respond jointly to new security threats; a Japanese declaration supporting the reunification of the Korean Peninsula under the Seoul government; an outline of shared values and interests, including maritime security threats and bilateral trade issues; and an ROK acknowledgement of Japan's contributions to regional security and its future security role.[44] Furthermore, McDaniel Wicker at the Wilson Center contends that, inter alia, a commitment among the three nations to meet in a "2 + 2 + 2" forum that comprises their respective defense and foreign ministers might yield increased alignment among the mutual political and military concerns of the United States, Japan, and the ROK.[45] These recommendations represent concrete steps toward the establishment of a flexible US-Japan-ROK trilateral defense agreement, as well as bridge-building measures to resolve persistent Japan-ROK disputes—a critical prerequisite to any US policy to shape and share the burden of security in the Asia-Pacific.[46] Together with mutual concern about a rising China, there is reason for optimism regarding a US-Japan-ROK political partnership.

Any such formal relationship, though, must begin with the already-strengthening military ties among the three nations. Stemming from their respective bilateral relationships with the United States, both Japan and the ROK possess modern military capabilities that integrate well. In the maritime realm, both the Republic of Korea Navy (ROKN) and Japanese Maritime Self Defense Force (JMSDF) tout mature, robust blue-water fleets. Although naturally concentrated on defense of their respective homelands, both the ROKN and JMSDF have proven their capability to operate with and within USN action groups through participation in regular exercises and global operations, including counterpiracy, humanitarian relief, and more. Demonstrating the potential for deeper military cooperation and coordinated action among the three countries, the USS *George Washington* carrier strike group participated in a June 2012 trilateral naval exercise with ROKN and JMSDF units in the East China Sea, emphasizing disaster relief and maritime security.[47] Moreover, the ROKN and JMSDF have been characterized as "destined to cooperate" due to their shared interests in defense against North Korea and China, particularly in the area of antisubmarine warfare and in common trade and access challenges.[48] Trilateral commitment to protocols for dealing with incidents at sea and in the air is another area for potential cooperation.[49] Some people suggest the development of a US-PRC agreement similar to the Incidents-at-Sea Agreement that the United States established with the former Soviet Union during the Cold War era. However, such an agreement may be unnecessary, given existing modern international protocols that

were largely not in force at the time of the signing.[50] Instead, a US-Japan-ROK partnership would assist the international community in holding the PRC accountable under existing protocols, adding regional legitimacy to calls for adjudication of incidents by responsible international governing bodies.

Besides shared maritime defense, the air domain promises similar synergies among the three nations. The United States already enjoys a deep bilateral relationship with both Japan and the ROK regarding air-centric military exercises. The US-Japan Keen Sword series and the US-ROK collection of Ulchi Freedom Guardian, Foal Eagle, and Max Thunder all do well to integrate the respective air forces and ensure proficiency and interoperability across an ever-changing body of operators. But some recent air exercises have involved all three nations, a practice that should be extended to a greater degree into other war-fighting domains, in line with benefits already seen in Europe under the European Reassurance Initiative. Red Flag Alaska 13-3 took place in August 2013, encompassing approximately 60 aircraft and 2,600 personnel. It focused on humanitarian assistance training, air base opening, aeromedical evacuation, and air combat training, including air-to-air and air-to-ground events within a large-force employment exercise. For the first time since Red Flag Alaska's inception in 1976 (then known as Cope Thunder), both Seoul and Tokyo sent six F-15s each from their air forces to participate in the theater-level air war simulation. Both the Republic of Korea Air Force and the Japanese Air Self Defense Force (JASDF) had participated in Red Flag exercises before but never simultaneously.

Similarly, Asia-Pacific's Cope North exercise, active since 1978, continues to mature. Nearly 2,000 military members participated in Cope North 2015; the United States, Australia, Japan, the ROK, New Zealand, and the Philippines contributed operators, and members of the Singapore and Vietnam air forces observed. This 86th iteration of the exercise, held in February 2015 at Andersen AFB, Guam, concentrated on "interoperability and . . . combat readiness . . . [to] develop a synergistic disaster response capability between [*sic*] the countries involved."[51] US Air Force colonel David Mineau, the Cope North exercise director, recognized the importance of deeper multilateral ties "so we can learn from each other. . . . Coming together, we can hone our abilities by listening to each other, increasing our interoperability, and sharing techniques, tactics and procedures to make us more effective and to promote peace and stability in the region."[52]

During an air-based demonstration of military cooperation to protest jointly China's regional aggression, the ROK and Japan in December 2013 conducted a search-and-rescue military exercise in the vicinity of China's controversial ADIZ. The ROK and JASDF forces did not file flight plans, contrary to Chinese guidance for the ADIZ, following the example set by the United States at the ADIZ's inception.[53] In response to China's establishment of the "provocative" East China Sea ADIZ, the United States conducted an overflight of two B-52s. This act not only reinforced support for Japan but also served as a "demonstration of long-established international rights to freedom of navigation and transit through international airspace."[54] Finally, there are also efforts to pursue a trilateral missile defense system among the United States, Japan, and the ROK.[55] Overtly, to counter the increasing North Korean nuclear and ballistic missile threat, this initiative to erect an integrated and interoperable

missile defense system would also help check Chinese regional aggression by countering that nation's burgeoning cruise missile capabilities.

Unquestionably, "a contingency on the Korean Peninsula could affect Japan and . . . a contingency in Japan could affect South Korea. . . . Inadequate cooperation will not only help the adversary in a specific contingency but also serve a third party in the region. In the worst case it would greatly damage the national interests of both nations, as well as those of the United States."[56] However, a cohesive, interoperable, and strong trilateral relationship that could flexibly respond to any shared regional concern would provide a credible regional deterrent. Deepening and expanding these nascent US-Japan-ROK relationships to support and enable a trilateral defense arrangement are key ingredients to a US recipe for strategic flexibility and effective dissuasion.

Force Structure: Increasing Survivability and Options

Strategic flexibility also requires agile, survivable forces that are not restricted to specific geographical locales or confined to respond to specific threats. Reevaluating the US force posture in the ROK, relying more upon persistent naval presence, and increasing the survivability of key Asia-Pacific locales are three ways the United States might shift its existing Asia-Pacific force structure in support of strategic flexibility.

In 2007 the ROK sought full operational control (OPCON) of its wartime forces from the United States. This request resulted in an agreement to transfer OPCON by April 2012.[57] Part of the agreement included ROK guarantees to fill gaps in its military technology and war-fighting capabilities that were most reinforced by the United States, particularly naval and air platforms but also "missile defense and state-of-the-art C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance)."[58] To date, however, the ROK has not managed to increase defense spending sufficiently to attain the necessary military upgrades as outlined in its *Defense Reform Plan 2020*, a fact that may indicate a general reluctance to complete the OPCON transfer, now delayed from December 2015 to an indefinite date.[59] The transfer of wartime OPCON to the ROK represents a key enabler to a US policy of strategic flexibility by allowing America to reduce its military footprint in the ROK or to use those forces in response to a military confrontation external to the Korean Peninsula. Attaining the military capabilities to support the US pursuit of a more strategically flexible force would also bring to the ROK the added benefit of facilitating the as-yet-unrealized "long desire to achieve 'Self-Reliant Defense.' "[60] Because the continued delay of OPCON transfer reduces US military flexibility to respond to other crises in the Asia-Pacific region, the United States should consider increased financial and political incentives for the ROK to expedite the transfer. Once the latter is complete, America and the ROK can then consider basing and force-structure options that might better strengthen a trilateral regional response in a meaningful way.

Increased naval presence in the Asia-Pacific offers another alternative to ground-based forces—one that should contribute to greater strategic flexibility. Already, "in addition to U.S.-based aircraft carriers and expeditionary strike groups conducting

rotational deployments to the region, there are 23 ships and submarines forward deployed to U.S. facilities throughout U.S. 7th Fleet. . . . C7F includes forces forward deployed to Japan and Guam," according to the commander, US Seventh Fleet.[61] This sizeable and permanent "Forward Deployed Naval Force" in-theater reduces the response time demanded in a regional crisis and operates in concert with rotationally deployed units based in the continental United States.[62] Increasing this presence would avoid some of the limitations resident with air and ground forces operating from host nation bases. Depending upon the status-of-forces agreements (SOFA), host nations often impose limitations on the operations of US military units. For example, operations originating from the host nation may participate in its direct defense but may not permit lethal action against a third party. Even on a case-by-case basis, SOFAs can impose serious limitations on US freedom of movement while sea-based units, even if operating from US facilities in host nations, usually bring no such political constraints.[63]

Improving the survivability of key strategic locations vulnerable to PRC and North Korean ballistic missile and cruise missile threats would also contribute to strategic flexibility. As an example, sizeable US and Japanese Self Defense Force forces on Okinawa are not only necessary to respond to any regional military conflict but also extremely vulnerable to missile attack. To address this concern, the 18th Wing at Kadena Air Base on Okinawa initiated an annual "defense of Okinawa working group" in 2007. Since the initial session, which consisted only of US Air Force personnel, the group has met multiple times and grown to include over 120 joint US partners, as well as elements of the JASDF and Japanese Ground Self Defense Force. This body of subject-matter experts identifies employment gaps and then exercises jointly either to validate or reject island defense concepts. Now known as the Bilateral Defense of Okinawa Working Group (BDOWG), it examines issues such as integrated air and missile defense, distributed command and control in a contested environment, and dispersal options should defense of the island fail. By establishing "business rules" in advance of conflict, BDOWG participants have established airspace and timing agreements to deconflict missile defense shot options, erected various command and control alternatives related to loss of connectivity with higher echelons, and discovered that dispersing US military assets to increase survivability exerts significant negative effects upon the generation of combat sorties. BDOWG concepts have been used to inform emergent Pacific operation plans and have found their way to Air Combat Command's Weapons and Tactics Conference to inform and potentially adapt similar relationships with international and joint partners in other theaters. Mechanisms like the BDOWG strengthen international military partnerships and address real-world military employment challenges to increase survivability, ultimately preserving combat options within a posture of Asia-Pacific strategic flexibility. This process can be easily replicated for other key Asia-Pacific sites and can include a larger range of allies and partners.

Conclusion

If a US policy of strategic flexibility based in dissuasion is to produce its desired effect, then policy makers must first recognize that "understanding [deterrence] means facing up to the fact that it is inherently imperfect. . . . It must be approached with care and used as part of a larger tool kit."[64] In line with the DOD's joint operating concept on deterrence, "effective deterrence involves far more than just DOD capabilities, operations, and activities. . . . It demands a national level effort involving extensive interagency (and in some cases, intra-alliance) integration and coordination."[65] Thus, the policy proposed here requires commitment from all instruments of US national power, especially to bring to fruition the complex trilateral defense arrangement among the United States, Japan, and the ROK. Such a relationship would not only counter a resurgent China but also share the burden of the mutual defense of all three nations during a period of fiscal retraction. Moreover, it would enable the projection of US military power in the Asia-Pacific without entangling preconditions—a critical element to strategic flexibility as defined here. Beyond the trilateral arrangement, rethinking Asia-Pacific force structure to reduce reliance upon standing ground forces tied to a specific response, as well as pursuing constructive multilateral mechanisms to increase survivability and response options, would also contribute to a policy of strategic flexibility and effective regional dissuasion. It is important not to "discount . . . dissuasion['s] . . . effect upon behavior, . . . perceptions of U.S. military power and of the likelihood that it would be employed. Possession of a very powerful military machine, and a solid reputation for being willing to use it, casts a shadow or shines a light . . . in many corners of the world. That shadow, or light, may have a distinct deterrent effect, even in the absence of explicit American efforts to deter."[66] When complemented by its positive, assuring effects on allies and regional partners, dissuasion unhindered and empowered through a US Asia-Pacific defense posture of strategic flexibility can even prevent conflicts once considered inevitable. ✪

Notes

1. The Japanese Air Self Defense Force scrambles in response to Chinese and Russian aircraft penetrating the Japanese ADIZ have risen each year from 158 in 2003 to 810 in 2013. Of these, scrambles in response to Chinese incursions represented 21.5 percent of the total in 2003, rising to 51.2 percent of the total by 2013.

2. "What Would America Fight For?," *Economist*, 3 May 2014, http://www.economist.com/news /leaders/21601508-nagging-doubt-eating-away-world-orderand-superpower-largely-ignoring-it-what?frsc =dg%7Cd.

3. *Strategic flexibility* is the ability to project military power against anticipated, adaptive, or unexpected global threats without preconditions imposed by external entities. The concept of strategic flexibility emerged in numerous official US documents, including the 2001 *Quadrennial Defense Review Report*, the 2002 *National Security Strategy of the United States of America*, and the 2003 *Global Defense Posture Review*. The specific term *strategic flexibility* is more commonly associated with US forces in Korea. It was noted as a goal, albeit undefined, in the 35th US–Republic of Korea (ROK) Security Consultative Meeting Joint Communiqué in 2003. In this context, strategic flexibility permits the United States to relocate troops stationed in the ROK to other regions or theaters, thus facilitating strategic flexibility. The latter requires sufficient agile, flexible, and expeditionary military forces, both at home and

abroad. These forward-stationed and deployed forces are multifunctional so they can be surged quickly to deal with unexpected threats.

4. Thomas C. Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1966).

5. Gen Norton A. Schwartz and Lt Col Timothy R. Kirk, "Policy and Purpose: The Economy of Deterrence," *Strategic Studies Quarterly* 3, no. 1 (Spring 2009): 21. For a discussion of strategic deterrence, see Department of Defense, *Deterrence Operations Joint Operating Concept*, version 2.0 (Washington, DC: Department of Defense, December 2006), 56, http://www.dtic.mil/doctrine/concepts/joint_concepts /joc_deterrence.pdf. This article's use of *dissuasion* mirrors that of Schwartz and Kirk (see above) and can be considered almost synonymous with strategic deterrence as defined in the DOD's *Deterrence Operations Joint Operating Concept*.

6. Schwartz and Kirk, "Policy and Purpose," 18–19.

7. Ibid., 17.

8. "What Would America Fight For?"

9. Ibid.

10. David C. Gompert and Phillip C. Saunders, *The Paradox of Power: Sino-American Strategic Restraint in an Age of Vulnerability* (Washington, DC: National Defense University Press, 2011), 47.

11. As examples, the PRC separately constituted and deployed the People's Volunteer Army to combat US and Korean forces during the Korean conflict rather than simply using elements of the People's Liberation Army to avoid an "official" war with the United States and possible escalation. Similarly, during the Taiwan Strait Crisis of 1954–55, and again in 1958, the PRC intentionally avoided the impression of invading the key islands of Kinmen and Matsu because such an act could be seen as a prelude to the invasion of Taiwan and inspire US military action in response. See 林賢参, "冷戦期における中国の武力行使の行動パターン －抑止論の観点から論ずる－," 問題と研究36, no.4 (July/August 2007): 105.

12. Japan Ministry of Defense, *Defense of Japan, 2014*, white paper (Tokyo: Japan Ministry of Defense, 2014), 35, http://www.mod.go.jp/e/publ/w_paper/pdf/2014/DOJ2014_1-1-3_web_1031.pdf.

13. Ryoji Nakagawa, "The New Stage of Foreign Policy of China: Adaptation for International Order and Creation of New Order," 立命館国際地域研究, no. 33 (March 2011): 30.

14. By extending its claims of sovereignty over resource-rich coastal areas incrementally during this period, using force in the Battle of the Paracel Islands in 1974, and again in the Spratly Islands in 1988, the PRC used its growing military to supplement the country's expanding economy.

15. Mike Bird, "China Just Overtook the US as the World's Largest Economy," Business Insider, 8 October 2014, http://www.businessinsider.com/china-overtakes-us-as-worlds-largest-economy-2014-10. If one measures economic strength by purchasing power parity, then China's GDP would rank first in the world.

16. As examples, the ROK in 2013 experienced an export trade value of 26.1 percent to the PRC, more than double the same relationship with the United States. The ROK's export dependency is also extremely high, comprising about 43 percent of its GDP in 2013. Taiwan's situation is similar, with its export trade value to the PRC at 26.8 percent and its export dependency standing at 62.4 percent. See "韓国経済と日韓経済関係," mofa.go.jp, December 2014, http://www.google.com/url?sa=t&rct=j&q =&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0CCMQFjAB&url=http%3A%2F%2Fwww .mofa.go.jp%2Fmofaj%2Ffiles%2F000005986.pdf&ei=Is7oVNy9CsWjNsrKg6AO&usg=AFQjCNFA5gHe 2nJ-Y_31_elnbg8dIW5lpQ&sig2=7T8l UGT02CQBrqlHWnSVZA (Hong Kong and Taiwan are not included in the figures); "経済部：中国大陸への経済的依存度は深まっていない," taiwanembassy.org, 4 July 2014, http://www.taiwanembassy.org/ct.asp?xItem=523896&ctNode=1453&mp=1 (Hong Kong is not included in the figures); and "世界の輸出依存度 国別ランキング・推移," globalnote.jp, 1 December 2014, http://www.globalnote.jp/post-4900.html.

17. Aaron Austin, "China's Subtle Strategy in the South China Sea," *United States Institute of Peace Peacebrief* 154 (24 July 2013): 4, http://www.usip.org/sites/default/files/PB154-China%E2%80%99s%20 Subtle%20Strategy_0.pdf.

18. "China's Defense Budget," GlobalSecurity.org, accessed 13 June 2016, http://www.globalsecurity .org/military/world/china/budget.htm.

19. US Naval Institute, "WEST 2014: What About China?," YouTube video, 1:18:01 (James Fanell, 22:19-minute mark of video), http://www.youtube.com/watch?v=wWhwm4SJxTw&list=PLWX4R7nG6a 8moOpTaK1Zs41qPmPzjhxmj&feature=c4-overview-vl. See also Michael D. Swaine et al., *China's Mili-*

tary and the U.S.-Japan Alliance in 2030: A Strategic Net Assessment (Washington, DC: Carnegie Endowment for International Peace, 2013), 308.

20. US Naval Institute, "WEST 2014" (James Fanell, 26:19-minute mark of video).

21. The term *reemerge* or *reemergence* is synonymous with the more commonly used term *rise* as in "the rise of China" or "the reemergence of China."

22. Ida Torres, "US, Japan Agree to Revise Mutual Defense Treaty for First Time in 16 Years," *Japan Daily Press*, 3 October 2013, http://japandailypress.com/us-japan-agree-to-revise-mutual-defense-treaty-for-first-time-in-16-years-0337105/.

23. Hannah Beech, "What's New on China's Artificial Islands in the South China Sea? Basketball Courts," *Time*, 22 May 2016, http://time.com/4341510/south-china-sea-artificial-islands. See also Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015* (Washington, DC: Office of the Secretary of Defense, 7 April 2015), http://www.defense.gov/Portals/1/Documents/pubs/2015_China_Military_Power_Report.pdf.

24. US Naval Institute, "WEST 2014" (James Fanell, 29:10-minute mark of video).

25. Arshad Mohammed and Kanupriya Kapoor, "Asia-Pacific Stability Depends on Success of ASEAN Code of Conduct: Kerry," Reuters, 17 February 2014, http://www.reuters.com/article/2014/02/17/us-indonesia-kerry-asean-idUSBREA1G15K20140217.

26. The Republic of China is typically known as Taiwan.

27. Governments of the United States of America and Japan, "Treaty of Mutual Cooperation and Security between the United States of America and Japan," Washington, DC, 19 January 1960, Article V, 2.

28. "Unlike other defense treaties with allies, this pledge [US-Japan Treaty] is not mutual: Japan is not obligated to defend the United States if it is attacked." Emma Chanlett-Avery and Ian E. Rinehart, *The U.S.-Japan Alliance*, CRS Report RL33740 (Washington, DC, Congressional Research Service, 9 February 2016), 28, https://www.fas.org/sgp/crs/row/RL33740.pdf.

29. Ibid., 2.

30. "The U.S. Needs to Rebuke a Japanese Ally," Bloomberg, 20 February 2014, http://www.bloomberg.com/news/articles/2014-02-20/japans-abe-deserves-u-dot-s-dot-rebuke-for-inflaming-tensions-in-asia.

31. Ibid.

32. Bonnie Glaser, "US Interests in Japan's Territorial and Maritime Disputes with China and South Korea" (discussion paper, Territorial Issues in Asia—Drivers, Instruments, Ways Forward: 7th Berlin Conference on Asian Security, 1–2 July 2013), 5, http://www.swp-berlin.org/fileadmin/contents/products/projekt_papiere/BCAS2013_Bonnie_Glaser.pdf.

33. US Naval Institute, "WEST 2014" (James Holmes, "China: Strategic Challenges," 13:20-minute mark of video).

34. Torres, "US, Japan Agree."

35. "Press Conference: Presidents Obama and Park," United States Embassy, 25 April 2014, http://www.uspolicy.be/dossier/north-korea-united-states-policy-toward-north-korea-dossier. The Trans-Pacific Partnership (TPP) is a proposed regional economic treaty that has become a top goal for President Obama. The proposal started in 2005 as the Trans-Pacific Strategic Economic Partnership Agreement (TPSEP or P4) and was expected to be ready for implementation by 2012. However, contentious issues such as intellectual property and investments have delayed negotiations. By the end of 2014, 12 nations in the Asia-Pacific region have been part of TPP negotiations.

36. "Seoul Appears Set to Join Trans-Pacific Partnership Negotiations," *Hankyoreh*, 4 October 2013, http://english.hani.co.kr/arti/english_edition/e_international/605796.html.

37. President of the United States, *National Security Strategy* (Washington, DC: White House, February 2015), 24, https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf.

38. "Japan Says Close to Deal with South Korea and U.S. on North Korea Defense," Reuters, 26 December 2014, http://www.reuters.com/article/2014/12/26/us-japan-defence-southkorea-usa-idUSKBN0K40FL20141226.

39. Daniel Sneider, "As North Korea Heats Up, South Korea and Japan Should Warm Ties," *Christian Science Monitor*, 15 May 2013, http://www.csmonitor.com/Commentary/Opinion/2013/0515/As-North-Korea-heats-up-South-Korea-and-Japan-should-warm-ties.

40. Ibid. Koreans call the islets Dokdo (Rock) Island while the Japanese use Takeshima (Bamboo) Islands.

41. Sandeep Chakravorty, *China-Japan-Korea: Tangled Relationships*, Occasional Paper no. 39 (New Delhi: Observer Research Foundation, March 2013), 18, http://www.orfonline.org/wp-content/uploads/2013/03/OccasionalPaper_39.pdf.

42. Brad Glosserman, "Japan and South Korea: Don't Let History Dictate the Future," *Christian Science Monitor*, 26 March 2014, http://www.csmonitor.com/Commentary/Common-Ground/2014/0326/Japan-and-South-Korea-Don-t-let-history-dictate-the-future.

43. Sneider, "North Korea Heats Up."

44. Glosserman, "Japan and South Korea."

45. McDaniel Wicker, "Completing the Triangle: Executive Summary," Wilson Center, 2 June 2016, https://www.wilsoncenter.org/publication/completing-the-triangle-executive-summary.

46. Michael Schuman, "Will America's Budget Deficit Bring an End to World Peace?," *Time*, 6 July 2011, http://business.time.com/2011/07/06/will-americas-budget-deficit-bring-an-end-to-world-peace/.

47. "US, South Korea and Japan to Conduct Trilateral Naval Exercise," naval-technology.com, 15 June 2012, http://www.naval-technology.com/news/newsus-south-korea-japan-conduct-trilateral-naval-exercise.

48. Samuel J. Mun, " 'Destined to Cooperate:' Japan-ROK Naval Cooperation and Its Implication for U.S. Strategic Interests in Northeast Asia," Project 2049 Institute, 31 January 2014, http://www.project2049.net/documents/Japan_ROK_naval_cooperation_Sam_Mun.pdf.

49. For a detailed discussion of maritime and air incidents prior to 2012, see Pete Pedrozo, "The U.S.-China Incidents at Sea Agreement: A Recipe for Disaster," *Journal of National Security Law and Policy* 6, no. 1 (3 July 2012), http://jnslp.com/wp-content/uploads/2012/08/07_Pedrozo-Master.pdf.

50. Such international and regional protocols include the International Regulations for Preventing Collisions at Sea (COLREGS), Military Maritime Consultative Agreement (MMCA), Western Pacific Naval Symposium (WPNS), Code for Unalerted Encounters at Sea (CUES), International Code of Signals, United Nations Convention on Law of the Sea (UNCLOS), and the International Civil Aviation Organization Rules of the Air (ICAO). Additionally, the PRC and People's Liberation Army Navy are very different than the Soviet Union and Soviet Navy of the 1970s. See Pedrozo, "U.S.-China Incidents at Sea Agreement."

51. Melissa B. White, "Cope North 15 Kicks Off at Andersen," US Air Force, 18 February 2015, http://www.af.mil/News/ArticleDisplay/tabid/223/Article/566411/cope-north-15-kicks-off-at-andersen.aspx.

52. Ibid.

53. "S. Korea, Japan Conduct Search, Rescue Drill in East China Sea," Yonhap News Agency, 12 December 2013, http://english.yonhapnews.co.kr/national/2013/12/12/23/0301000000AEN20131212007100315F.html.

54. Thom Shanker, "U.S. Sends Two B-52 Bombers into Air Zone Claimed by China," *New York Times*, 26 November 2013, http://www.nytimes.com/2013/11/27/world/asia/us-flies-b-52s-into-chinas-expanded-air-defense-zone.html?_r = 0.

55. "Interoperable Missile Defense Architecture: Official," *Korea Times*, 21 February 2015, http://www.koreatimes.co.kr/www/news/nation/2015/02/113_173859.html.

56. Vice Adm Yoji Koda, "The Emerging Republic of Korea Navy: A Japanese Perspective," *Naval War College Review* 63, no. 2 (Spring 2010): 32.

57. Mon-soon Song, "Northeast Asia and the ROK-US Alliance: Why the Alliance Is Vital for the Region and for the United States," *American Foreign Policy Interests: The Journal of the National Committee on American Foreign Policy* 30, no. 2 (18 April 2008): 61.

58. Shelley Su, "The OPCON Transfer Debate," in *SAIS US-Korea 2011 Yearbook* (Baltimore: Paul H. Nitze School of Advanced International Studies, Johns Hopkins University, 2012), 163, http://uskoreainstitute.org/wp-content/uploads/2013/10/Su_YB2011.pdf.

59. Bruce Klingner, "OPCON Transfer: Timing Isn't Everything," Heritage Foundation, 8 July 2010, http://www.heritage.org/research/commentary/2010/07/opcon-transfer-timing-isnt-everything.

60. Soonkun Oh, "The U.S. Strategic Flexibility Policy: Prospects for the U.S.-ROK Alliance" (master's thesis, Naval Postgraduate School, December 2006), 22, http://calhoun.nps.edu/bitstream/handle/10945/2483/06Dec_Oh.pdf?sequence = 3&isAllowed = y.

61. PGEARHISER, "U.S. 7th Fleet: Confidence and Skill in the Navy's Largest Area of Operation," *Navy Live* (blog), 31 May 2012, http://navylive.dodlive.mil/2012/05/31/ u-s-7th-fleet-confidence-and-skill-in-the-navys-largest-area-of-operation/.

62. The Fleet Deployed Naval Force consists of one aircraft carrier, one command ship, two guided-missile cruisers, and seven guided-missile destroyers in Yokosuka, Japan; one amphibious assault ship, two dock landing ships, one dock transport ship, and four mine countermeasure ships in Sasebo, Japan; and one submarine tender and three fast attack submarines in Guam.

63. This is not to say that the host nations give the USN a "blank check." There may be limitations on resupply in or return to port if the host nation does not concur with action taken by US forces. As in all cases, negotiations with the host nation will be critical to ensure freedom of action.

64. Patrick M. Morgan, *Deterrence Now* (Cambridge, UK: Cambridge University Press, 2003), 285.

65. Department of Defense, *Deterrence Operations Joint Operating Concept*, 56.

66. Colin S. Gray, *Maintaining Effective Deterrence* (Carlisle, PA: US Army War College, Strategic Studies Institute, August 2003), 29, http://www.strategicstudiesinstitute.army.mil/pdffiles/PUB211.pdf.

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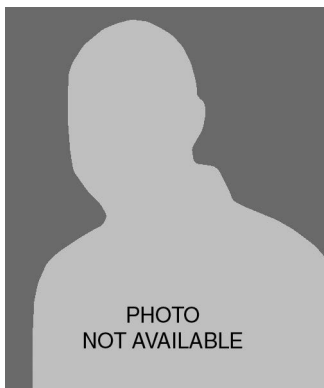
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The Best Aircraft for Close Air Support in the Twenty-First Century

Maj Kamal J. Kaaoush, USAF

Introduction and Background

In a presentation to a Senate-led defense appropriations hearing, the incumbent Air Force secretary, Deborah Lee James, painted a very grim picture in the face of economic sequestration. "Today's Air Force is the smallest it's been since it was established in 1947," she explained, "at a time when the demand for our Air Force services is absolutely going through the roof."[1] Because of far-reaching governmental budget constraints, the Air Force is being forced to make strategic decisions regarding the levels of manning and aircraft to maintain tactical readiness. In 2013 the service responded to a $12 billion budget reduction by cutting nearly 10 percent

of its inventory of aircraft and 25,000 personnel, necessitating the reduction of flying squadrons and overall combat capability.[2] With sequestration scheduled to last until 2023, however, the budget shows no sign of being restored any time soon. Consequently, Air Force senior leaders must continue to make tough decisions.[3]

A number of military experts have proposed eliminating less important "mission sets" by retiring aging airframes and replacing them and their single-role effectiveness with multirole aircraft.[4] To meet mounting budget demands, the Air Force chose the A-10 Thunderbolt as the first aircraft to place on the budgetary chopping block. This exclusive air-to-ground asset specializes in delivering multiple forms of munitions to provide close air support (CAS) and protect ground operations. Highlighting the potential savings of $4.2 billion in operations and sustainment costs, Gen Mark Welsh, the former chief of staff of the Air Force, wanted to reinvest those savings in multirole aircraft like the F-35 that "can not only do CAS, but can also survive in a high-end fight."[5] He argued that the F-35 is just as capable as the A-10 in delivering CAS and that it offers more incentives, such as fewer operating hours, stealth capabilities, and enhanced speed.

On the battlefield, CAS will continue to be an essential mission. Additionally, modern-day counterinsurgency operations require precision engagement of enemy forces to protect friendly forces on the ground, prevent fratricide, and minimize collateral damage.[6] Munitions dropped off target can wreak havoc in civilian populations, killing innocent people and hurting campaign support. Because CAS plays such a critical role in combat operations, the Air Force must ensure that it has capable aircraft that can sustain CAS operations in the face of budgetary crises. The service's senior leaders believe that after they retire the A-10 in 2019, the F-35 will have become fully operational and a capable replacement, working alongside legacy aircraft (like the F-16) to conduct CAS in future operations.[7] In an environment where every second counts and multiple air assets can be called on at a moment's notice, can the F-35 and other legacy systems really deliver the same level of performance as their predecessor? Will retiring the A-10 actually save the money needed to meet Air Force sustainment costs if other platforms are asked to perform the same roles?

This article examines the following question: Which aircraft (or combination of platforms) is the best option to lead and sustain the Air Force's CAS capability in the twenty-first century? To answer this question, the article evaluates a variety of aircraft that perform CAS in modern-day operations, based on the service's requirements outlined above. However, one must first operationally define the role of CAS in this study. Joint Publication 3-09.3, *Close Air Support*, denotes it as "air action by fixed-wing . . . and rotary-wing . . . aircraft against hostile targets that are in close proximity to friendly forces[, requiring] . . . detailed integration of each air mission with the fire and movement of those forces."[8] In addition to CAS, the Air Force employs its aircraft to perform a myriad of roles during combat operations, such as offensive counterair, defensive counterair, suppression of enemy air defenses, destruction of enemy air defense, combat search and rescue, and so on. However, to make the comparison simpler and easier to quantify, this article aligns those operational roles into three distinct categories: air superiority, air interdiction, and CAS. Despite the evolution of airpower doctrine over time, these basic categories have remained an order of operations for air-lead joint campaigns; this study concerns itself only with

CAS. The basic idea is that air superiority missions would start by eliminating any threat to air operations, such as antiaircraft weapons or enemy aircraft. Second, air interdiction would involve strategic air-to-ground engagement, targeting command, control, and communications nodes and positioned enemy forces. Finally, CAS would involve aircraft support to friendly ground forces, specifically supporting troops in contact with enemy forces. This definition of CAS is more specific than the joint version and offers a better picture of what is expected from a solid CAS platform: precision engagement of enemy forces in close proximity to friendly forces conducting ground operations. This denotation, though brief, summarizes what joint doctrine characterizes as effective CAS. The following conditions, when employed concurrently, increase the effectiveness of CAS: effective training and proficiency of aircrews and joint terminal attack controllers, command and control to achieve air-to-ground integration, air superiority to allow unrestricted access to target sets, target marking to avoid friendly fire and minimize collateral damage, streamlined and flexible procedures to expedite responsiveness, appropriate ordnance, and consideration of environmental conditions.[9] To further improve CAS responsiveness, the following techniques are also applied: deployment of CAS assets and personnel to forward operating locations for increased response and longer pattern-loiter duration, placement of aircrews and aircraft on alert status, delegation of authority to the lowest tactical level, and integration of joint terminal attack controllers and air liaison officers with ground units to streamline continuous command, control, and communications.[10]

Long before the Air Force began operating in the current state of perpetual budgetary trimming, the service's comptrollers analyzed and calculated complex algorithms and equations to predict budget proposals used every fiscal year. One such calculation is the annual cost per flying hour (CPFH), which tracks and analyzes operational and support costs maintained in a cumulative database called the Air Force Capability Assessment Program.[11] A report published in 1999 by the United States General Accounting Office noted that the Air Force had issues with flying its requested number of annual flying hours.[12] In an effort to become more efficient, each major command adopted a standardized methodology for tracking its flying-hour program, allowing for a more accurate request based on requirements specific to the major command. The first step to tracking a flying-hour program is determining a unit's sortie requirements, including the following factors: number of line pilots needed for combat mission readiness, experience level of pilots assigned (less experience necessitates more sorties), number of attached pilots fulfilling outside roles required to maintain basic mission-capable status, special mandatory capabilities (e.g., functional check-flight certifier or instructor pilot), and collateral sorties (e.g., ferry flights, deployments, and incentive flights).[13] After sortie requirements are tallied, they are converted to flying hours by using sortie duration estimates based on historical averages. Sortie duration will vary according to geographic location, aircraft type, aircraft configuration, aerial refueling, distance to bombing ranges, and so forth.[14] Once these figures are accumulated for each major command's fleet, the second step is developing a CPFH rate based on three types of maintenance and operations expenditures: depot-level repairable parts (e.g., engines or avionics line-replaceable units that can be repaired at maintenance facilities),

consumable supplies (nonrepairable supply items), and aviation fuel.[15] Once the flying hour rate and number of hours are determined by type of aircraft, the actual CPFH can be ascertained for use in this analysis. This information, although not widely disseminated, is calculated and made available by the Air Force's financial management and comptroller. This data is valuable to this study because the CPFH provides a dollar figure estimate to the actual costs of sustaining operations with a specific type of aircraft. Since budget constraints are the leading reason for retiring the A-10 in favor of multirole platforms, factoring actual CPFHs will reveal the more cost-effective option. All CPFH data used in this study for aircraft comparison comes from the comptroller's Air Force Capability Assessment Program database, released in 2013.[16]

To be as comprehensive as possible, this article reviews all of the aircraft that perform CAS in today's Air Force: AC-130s, remotely piloted aircraft (RPA), light attack aircraft (LAA), legacy fighter aircraft (F-16s and F-15s), F-35s, and A-10s. The criteria for evaluating these aircraft are based on the following considerations: design, fleet age, upgrades, capabilities, hardware, CPFH, stores capacity, range, speed, and time on target.

Attack helicopters like the Apache and Cobra have historically been used by the Army and Marine Corps for CAS, but they are not considered in this comparison for two reasons. First, although the Air Force currently has a small fleet of rotary-wing aircraft, they do not perform CAS in the traditional sense. The fleets of HH-60 Blackhawks employed in combat operations are limited to combat search and rescue operations, generally using small-arms fire to provide cover and conceal the deployment or retrieval of special forces personnel on board. Acquiring aged airframes from other services, standing up new operations and maintenance squadrons, or building the infrastructure necessary to accommodate them would be neither cost effective nor advantageous. Second, in the wake of the failed Comanche project (involving a stealth helicopter, cancelled because of budget cuts in 2004), the Army wants to replace its rotary-wing aircraft. Starting in 2009, that service initiated "future vertical lift," a modernization project to replace the Chinook, Blackhawk, and Apache helicopters by 2030.[17] Since the earliest prototypes are not predicted to be available until 2017, replacing combat-capable aircraft with modern attack helicopters will not be an option in the near term.[18] The combination of these two factors alone eliminates the helicopter as a viable source for Air Force CAS.

Neither are large-scale heavy bombers (the B-52, B-1, and B-2) included in this report although they are some of the oldest and most battle-proven aircraft in the Air Force inventory. The CPFH for bombers is too high to employ them without predetermined target sets, on the off chance that they fly and refrain from delivering munitions. Simply put, they are too expensive to loiter around and wait for CAS engagements. The B-1 is the most frugal of the three, costing $58,000 per hour.[19] That figure is more than twice the cost per hour of the F-16C and nearly three-and-a-half times that of an A-10.[20] The B-52 comes in second, with a price tag of almost $70,000 per hour.[21] Finally, the B-2, with its complex, low-observable profile and $2-billion-per-aircraft price tag, tips the scales at a massive $169,000 per hour—more than twice the rate of any other aircraft.[22] With the capability of these platforms to carry large stores of munitions, their ability to conduct precision engage-

ment of multiple targets simultaneously during one sortie, and their high operating costs, the CAS role for B-1, B-2, and B-52 bombers should be constrained, and the service should utilize these aircraft primarily for air interdiction and nuclear operations.

The AC-130 has been a reliable platform for the Air Force's special operations community since the original prototype was designed and built in 1953. The AC-130H uses a 40 millimeter (mm) cannon and a modified M102 Howitzer 105 cannon, both mounted in the side, while the AC-130U employs a 25 mm Gatling gun in place of the 40 mm cannon.[23] Programmed with more than 609,000 lines of software code to run its avionics and mission computers, the aircraft is also outfitted with a myriad of sophisticated targeting and navigation sensors to ensure tremendous accuracy: "During Vietnam, gunships destroyed more than 10,000 trucks and were credited with many life-saving close air support missions."[24] Furthermore, because it has the fuel capacity of a standard C-130, it enjoys a range of 1,300 nautical miles, allowing for increased loiter and time on target.[25] Despite these benefits, however, AC-130s were produced in small numbers, with only 8 H-models and 17 U-models in the Air Force inventory. Additionally, the AC-130 is a dedicated special operations forces asset, called on to deploy around the globe at a moment's notice. The combination of these two factors limits the Air Force's ability to rely on their availability in the joint environment and to employ them in CAS for standard operations. Although the new AC-130J can deliver standoff precision-guided munitions like the GBU-39 small diameter bomb and the AGM-176 Griffin missile, it is still in operational test and development.[26] The new squadron (replacement for the H and U models) is not slated to begin operations until fiscal year 2017, and, like its predecessor, it will also be produced in limited numbers.[27] Despite being a proven platform for CAS, its dedication to special operations forces, fleet age, and small numbers prevent it from being a candidate in this study. Thanks to a recent event in Jordan, however, the development of future gunship platforms could be on the horizon. Contracts between the King Abdullah II Design and Development Bureau of Jordan and Alliant Techsystems Incorporated were established to convert CASA 235 and 295 medium-range aircraft to gunships, using removable weapons and component guidance systems.[28] Though not included in this study, if this procurement project turns out to be a viable and cost-effective future option, there may be more talk of gunship CAS in the near future.

RPAs have emerged throughout the armed forces as versatile aircraft, used in military operations primarily for intelligence, surveillance, and reconnaissance (ISR) operations. RPAs such as the MQ-1 Predator and the MQ-9 Reaper have been employed around the globe, supplying real-time illumination of battlefield operations and providing much-needed intelligence for mission planning as well as on-going mission operations. But recently, RPAs have been given a second mission that the Air Force describes as dynamic target execution: "Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons—it provides a unique capability to perform strike, coordination, and reconnaissance against high-value, fleeting, and time-sensitive targets."[29] Essentially, since RPAs are constantly monitoring the battlespace in a real-time environment, they are superb candidates for eliminating short-notice targets of opportunity.

Ideally, these same traits would classify RPAs as prime candidates for CAS opportunities. The capabilities that allow RPAs to fly without pilots on board, however,

limit their reliability. In the last 14 years, large RPAs used by the US military have been involved in more than 400 crashes and major accidents.[30] The high number of incidents compared to those for aircraft with pilots in the cockpit can be attributed to four main factors: a lack of detection and avoidance technology, unreliable communications links, mechanical defects, and pilot error.[31] Simple interference caused by weather and bandwidth can have devastating effects; sensors, cameras, and complex avionics and guidance systems can never replace the eyes, ears, and nose of a human piloting an aircraft.[32] One example comes during operations in Afghanistan, where an inexperienced pilot accidently flew a Predator into the side of a mountain while helping troops on the ground.[33] Granted, mechanical defects can occur on any aircraft at any time, and given human nature, pilots in the cockpit make errors too. However, a pilot in a fighter aircraft will still be able to control that aircraft and avoid midair collisions because he or she does not require communications to control the platform. Although they are aptly suited for ISR and the destruction of dynamic targets, RPAs' inherent potential for unreliability from relatively minor factors during critical operations and high demand in current ISR roles make them a poor choice for dedicated CAS missions and support.

Qualitative Assessment and Relevant Information

Light Ground Attack Aircraft

Despite General Welsh's intent to modernize the Air Force with multirole aircraft, many experts believe that fielding lighter, more cost-effective, propeller-driven aircraft is a viable CAS option. Though many aircraft could fit in this category, this article uses Beechcraft's AT-6 for comparison since it is currently employed by the US Air Force, US Navy, and services of eight other nations. The platform was originally purchased for training purposes, but Beechcraft has created variations such as the AT-6B that the company says are capable of performing a wide variety of missions: counterinsurgency, CAS, forward air control, combat search and rescue, armed reconnaissance, airborne interdiction, civil support, disaster response, maritime patrol, and border security.[34] Equipped with a glass cockpit (multiple large multifunction displays and digital instruments), infrared cameras, laser capabilities (designator, illuminator, and range finder), and six weapons pylons, the TA-6B is a modern variant of the T-6A that the US Air Force uses for training.[35]

The T-6 has been fielded since May 2000, so the supply chain is already established and would be available for this relatively new fleet of aircraft, purchased straight off the production line.[36] CPFHs of newly purchased aircraft would be extremely low initially due to warranty considerations, rising to approximately $2,500/hour based on T-6A averages from 2009–13.[37] Another low-cost benefit is the overall expense per aircraft. The original T-6A cost as little as $4.2 million, but despite robust cockpit upgrades, avionics, and weapons pylons, the AT-6B is estimated to come in at only $8–10 million.[38] The stores capacity is humble compared to that of legacy aircraft. Despite its six stations and maximum load capacity of roughly 3,000 pounds, the standard configuration would range from 1,500 to 2,000 pounds,

consisting of 250-/500-pound laser-guided bombs, rockets, Hellfire missiles, or .50 caliber gun pods in order to maintain long-term loiter rates without refueling.[39] The employment of external fuel tanks for longer loiter times would reduce that number considerably to 1,000 pounds. Comparing such light aircraft to legacy aircraft, one sees that "the F-16 C/D carries 2,000 pounds of ordnance when loaded with 500-pound class munitions and 4,000 pounds when carrying larger 2,000-pound class munitions," whereas "the F-15E carries from 6,000 to 10,000 pounds, and the A-10 can carry up to 10,000 pounds of ordnance, during standard combat sorties."[40] The speed of the AT-6B is approximately 280 knots with a range of 900 nautical miles, giving it hours of loiter time without fuel tanks.[41]

Although the propeller motor allows longer range and loiter time with lower fuel consumption, compared to jet aircraft, the AT-6B's speed makes it more vulnerable to attack. A report by the Joint Chiefs of Staff in 1968 noted that "propeller aircraft had experienced loss rates up to five times higher than those of jet aircraft."[42] Although this report seems dated in its application to this study, since the Vietnam War, one finds few modern studies that analyze the loss rates of propeller-driven aircraft in war. This fact is largely due to the proliferation of jet engine technology, which replaced propeller-driven fighters/bombers with jet-driven variants, as witnessed during both the Korean and Vietnam wars. In Vietnam, for example, the only propeller-driven bomber aircraft, the A-1, was inevitably phased out by 13 different jet-engine-driven aircraft (the A-3, A-4, A-5, A-6, A-7, F-4, F-5, F-8, F-100, F-101, F-102, F-104, and F-105). Additionally, unlike most legacy aircraft systems, no variants of the T-6 are equipped with a radar warning receiver, which evaluates inbound threats to the aircraft. Consequently, the optimal air environment for the AT-6B would be uncontested with minimal enemy surface-to-air munitions or air-to-air threats. However, once air superiority is established, the AT-6B becomes an economic asset for CAS because propeller-driven aircraft like the T-6 were reported by the joint chiefs to be "nine times as effective as jet aircraft per sortie" in airborne interdiction and CAS missions such as destroying "trucks and watercraft" on the ground.[43] The slower speeds of propeller aircraft allow for better targeting, positive identification of forces (both enemy and friendly), and an increased chance of effective munitions employment. Couple those rates from 1968 with the upgraded cockpit, a modern Helmet Mounted Cueing System for targeting (comparable to that of legacy and next-generation aircraft), various data links (e.g. Link 16) and radios (e.g., UHF, VHF, and satellite communications), and night vision goggle compatibility, and the AT-6B proves to be a legitimate weapon for CAS.

A final consideration for implementation of the AT-6B is the ease of allocating money to pay for the new airframe. According to a study conducted in 2009 by Maj Steven Tittel, the cost savings in daily aerial refueling realized by replacing a squadron and a half of legacy aircraft (F-16s and F-15s, specifically) conducting operations in Iraq and Afghanistan with the AT-6B would pay for the acquisition of 36 LAAs.[44] Additionally, once the Air Force has acquired a predetermined number of LAAs, it would be able to roll those savings into other programs hit with budget cuts, increasing the service's capability in other areas. The only limiting factor is the operational environment since a fully laden T-6 has a ceiling of only 25,000 feet.[45] In a high-altitude environment like Afghanistan's (average altitude levels

range between 12,000 and 15,000 feet mean sea level), LAAs are at a greater risk from threats such as man-portable air defense systems despite a preestablished no-fly zone or air superiority construct.[46]

To summarize, since the AT-6B has extremely limited air-to-air defenses and thrives in an uncontested air-to-ground environment, the LAA cannot be a complete replacement for current fighter platforms. However, the LAA—like the AT-6B—is incredibly capable of providing CAS with a decent number of munitions for a fraction of the cost to operate, compared to its competitors. Capable of long ranges and high rates of time on target with minimal fuel, the LAA has the ability to loiter and employ various munitions, making it a terrific addition to the Air Force's CAS arsenal, especially in a time of reduced budgets.

Legacy Fighters: F-16/F-15/A-10

The three most prominent airframes for conducting CAS in Operation Iraqi Freedom and Operation Enduring Freedom were the F-16C, F-15E, and A-10. Although they were designed and fielded in the same generation, their capabilities vary considerably. Further, they share similar experience in combat and are thus candidates for being compared to each other and to suggested replacements like the LAA and the F-35.

The easiest way to differentiate among the three aircraft is by size and stores capability. All three can carry the same munitions (e.g., AGM-65s, guided bomb units [GBU], and missiles), but they can carry them in different numbers, increasing by aircraft in correlation with wingspan. The F-16, the smallest of the three, is able to carry only 4,000 pounds of munitions.[47] Increasing in wingspan from 10 meters (m) to 13, the F-15E can handle 6,000 to 10,000 pounds.[48] With a wingspan of 18 m (the only aircraft among the legacy fighters that is wider than it is long), the A-10 dwarfs the other two, carrying a maximum load of 16,000 pounds.[49]

The fleet ages of the A-10 and F-16 are similar; the first production models were introduced to the Air Force in 1975 and 1979, respectively, and have been used extensively in combat operations since then. The F-16 proved its capability as a multirole fighter by performing suppression of enemy air defenses, offensive counterair, defensive counterair, CAS, and forward air controller missions in Operation Allied Force—and by flying more sorties than any other aircraft in Operation Desert Storm.[50] The A-10 has also seen considerable combat time, flying in more than 10 operations, including several unit deployments to Afghanistan and Iraq to perform CAS to support ground operations.[51] The F-15C and D models were introduced the same year as the F-16, but the Strike Eagle F-15E did not come to the Air Force until 1988.[52] Designed as a dual-role air-to-air and air-to-ground fighter, the F-15E shares little more than a basic design structure with its predecessors.[53] With a stronger landing gear, conformal fuel tanks, a specialized rear cockpit for a weapons officer, and low-altitude navigation and targeting infrared for night (LANTIRN) capability, the F-15E is well suited for the CAS environment. Moreover, because it was designed and released almost 10 years after the F-16 and A-10, its fleet average number of flying hours is lower. Unlike the A-10, both the F-15E and the F-16 are owned by other militaries, allowing for a larger pool of parts and interagency support.

The A-10's claim as a dominant CAS platform comes from its very design. Created specifically for the role of supporting ground troops in combat, the plane was built around a 30 mm Gatling gun fired from the nose of the aircraft.[54] Its engines were mounted on top of and outside the fuselage, permitting the A-10 to operate in austere conditions and dirt runways—and to keep them away from internally stored fuel in the case of battle damage.[55] Additional protection from small-arms fire includes fuel tanks lined with a fuel-activated congealing agent; redundant flight controls; nonhydraulic, redundant flight control systems; and a titanium bathtub to protect the pilot.[56] One drawback, compared to its counterparts, is that the A-10 lacks a radar warning receiver—useful for assessing air-to-air threats. However, the entire A-10 fleet was upgraded in 2007 to the A-10C designation, denoting newer communications, countermeasures, navigation, and display equipment in the cockpit.[57]

In addition to weight, the A-10 has the largest stores-carrying capacity. With 11 pylons, it is the most configurable of the airframes and can be used in conjunction with triple ejector racks and dual rail adapters to increase the number of bombs and missiles (respectively) held on each pylon. In a common combat configuration, this capability allows the A-10 to carry dual air-to-air missiles and electronic countermeasures for protection, without sacrificing its air-to-ground payload. The F-15E has seven pylons for mounting munitions, with additional stations for hanging only missiles. The F-16 has nine stations, but the two on the wingtips are capable of hanging only missiles while two more are often dedicated to holding wing tanks to increase range and sortie duration for CAS missions. Bullet quantities are a similar story. Both the F-15 and F-16 fire 20 mm rounds from the shoulder of the aircraft and can hold only 500 rounds in their internal gun drums.[58] The A-10's cannon, however, is in a league of its own. Not only does it carry 1,150 rounds of 30 mm ammunition in its internal drum (a larger quantity of higher caliber munitions) but also its ammo load contains depleted uranium armor-piercing rounds. These rounds, mixed with traditional high-explosive incendiary rounds, make the A-10 more effective against tanks and highly armored vehicles than the other platforms.

The cost to operate the A-10 is the lowest of the three legacy fighters; indeed, at $20,000 per flying hour, it is the cheapest of all the fighter aircraft in the Air Force inventory.[59] Prior to the upgrade to C-model designation, the total cost was almost $5,000 per hour cheaper than the current rate.[60] The F-16 is a close second, coming in at $23,000 to operate per flying hour, making it an economical option for a multirole/dual-mode aircraft. At $40,000, the F-15E is incredibly expensive compared to the other two but is the same price to operate as the older F-15C and D models.[61] That fact makes it a viable option for replacing the F-15C in a budget-constrained environment that emphasizes multirole aircraft and capability. One should note that the CPFH of the T-6A trainers is only $2,500.[62] Since the purchase price of the AT-6B is twice that of a T-6A, this article assumed that the CPFH to operate the AT-6B would be double the price. Even so, at that price, eight AT-6Bs cost as much per hour as one F-15.

In terms of speed, the two multirole jet-engine aircraft are the fastest: the F-15E can reach speeds of over 1,600 knots (Mach 2.5), and the single-engine F-16 can attain a more modest 1,300 knots (Mach 2).[63] Equipped with dual turbo-fan engines, the A-10 is much slower; unable to break the sound barrier, the A-10 has a maxi-

mum speed of a humble 400 knots.[64] Having the largest wings in the group, however, it is more maneuverable at those speeds.[65] Thus, the A-10 is capable of flying lower, making it better at identifying friendly and enemy forces on the ground to prevent collateral damage and "friendly fire" incidents.[66] The A-10 is the only aircraft designed to absorb small-arms fire with little risk to the aircraft, making it more effective at low altitudes. In addition to electronic countermeasures and munitions, the A-10 boasts self-sealing fuel tanks in the wings and a titanium bathtub to protect the pilot (mentioned previously), ultimately ensuring the aircraft's ability to return from battle intact. Capable of operating safely at lower altitudes, the A-10 can fly below clouds and inclement weather, allowing for target engagement in any conditions.[67] Although faster speeds permit fighter aircraft to respond more quickly to an emergency troops-in-contact situation, slower speeds also give the A-10 longer loiter times, which translates directly to increased battlefield coverage and precision engagement with traditional (fractionally less expensive, not enabled by the Global Positioning System) munitions.

Fuel savings from the turbofan engines give the A-10 more time in the air to loiter and fly. With a range of 2,240 nautical miles, it can fly nearly two-and-a-half times farther than the AT-6B.[68] Consequently, the A-10 can loiter for several hours without refueling. With a ceiling of 45,000 feet, it eclipses the AT-6B in terms of high-altitude combat capability.[69] The range for the F-15E is a close second at 2,100 nautical miles, which varies, depending on speeds traveled. The range of the F-16 is 1,740 nautical miles, and the aircraft can fly for almost three hours if ferrying speeds are kept to about 300 knots.[70] Roughly 500 knots is "a realistic response speed," however, giving F-16s roughly 45 minutes over target and requiring frequent refueling to loiter for longer periods of time.[71] The ceiling for the F-15 and F-16 is higher than that of the A-10 but is not influential in this comparison since the main focus is on ground engagement and anything above 40,000 feet would provide a similar capability.

Of the legacy fighters, the A-10 distinguishes itself from the rest as the best aircraft for providing ground support. Featuring a lower CPFH, lower speeds and altitude capability, longer loiter times, large capacity for stores, and redundant ground-threat-specific systems to protect both the airframe and its pilot, it lives up to its reputation as a platform built with one objective: providing CAS.

F-35

Senior Air Force officials have designated the F-35 as the A-10's replacement.[72] A multirole fighter similar to the F-16, the F-35 represents the next generation of fighter aircraft, promising upgraded capability and the latest in stealth technology. Lockheed Martin has seen several setbacks, including engine issues and structural cracks, in this nearly $400 billion program that has been in development for more than 12 years. In fact, the company has spent $170 million of its own money to cut government costs.[73] However, the acquisition timeline is on track, and 130 aircraft have been delivered to customers as of April 2015.[74] Preceded by the air-to-air-dominant F-22, the F-35 is the second fifth-generation fighter produced by Lockheed Martin, "optimized to be a multirole fighter, with the ability to perform air-to-air, air-to-

ground and intelligence, surveillance and reconnaissance (ISR) missions."[75] Only time will tell if it can perform CAS better than the legacy fighters.

Characteristics that set the F-35 apart from these fighters are advanced integrated avionics, advanced sensors, stealth capabilities, "enhanced situational awareness," and autonomic logistics.[76] Since it is a new aircraft, the fleet age and average hours will be the lowest possible; however, its newness allows for spontaneous issues and malfunctions unforeseen through development and testing. Unlike the AT-6B, the F-35 is not based on a previously flown aircraft. Since CPFH calculations have yet to be determined for the F-35, this article assumed that they are close to those of the now fully operational F-22 because of the aircraft's similarities (i.e., both are produced by Lockheed Martin and are fifth-generation stealth fighter aircraft). Although the cost for one hour started at more than $2.5 million during initial fielding, the F-22's CPFH is now roughly $70,000.[77] If the same holds true for the F-35, providing CAS will become a much more expensive endeavor compared to similar costs for the current fleet of fighters.

In terms of stores capability, the F-35 ranks higher than any other fighter, weighing in at 18,000 pounds.[78] The combination of advanced and conventional munitions is nearly identical to that of the F-16, with an internal shoulder-fired 25 mm gun replacing the F-16's 20 mm cannon. The one caveat, however, is that carrying more than 5,000 pounds of munitions is impossible without the use of external pylons because the standard configuration for the internal weapons bays is two 2,000-pound bombs and a pair of AIM-120 missiles.[79] Carrying additional munitions then limits the capability of the F-35 as a stealth aircraft since the increased surface areas and shapes change the radar signature of the aircraft. To be at all competitive with the A-10 in terms of conducting CAS, the F-35 will have to perform more like an F-16, increasing the price of operations threefold.

The standard load of the F-35 is internal only, limiting the amount of fuel it can accommodate without the use of external stores on each wing. The lack of externally stored fuel thus constrains the range of the F-35 to roughly 1,200 nautical miles—300 more than the AT-6B but 500 fewer than the F-16.[80] Range limited by stealth nixes the F-35's capability to provide CAS without constant refueling and a limited supply of munitions. Although it will be capable of conducting CAS for missions requiring stealth, the cost of operations will be higher, and the amount of support will be considerably lower than that in an environment where air superiority is in effect. Therefore, deploying the F-35 in a stealthy configuration adds costs if they are not truly required for mission success. For these types of scenarios, one would assume that the AC-130 would be a better candidate because it is already employed in special operations requiring more covert reinforcements, it carries much greater quantities of fuel for longer loiter capability, and it can deliver large quantities of ammunition while maintaining standoff distance. The speed of the F-35 is also mediocre when compared to that of other fighters; according to Lockheed Martin, the speed of a fully loaded, internally configured aircraft is only 1,050 knots (1.6 Mach)—250 and 550 knots slower than the F-16 and F-15E, respectively.[81] The benefit of having a slightly faster response time than the A-10 is overshadowed by a minimal loiter capability caused by shorter range and limited fuel stores when responding to a troops-in-contact scenario.

Recommendations/Conclusion

This comparative analysis has demonstrated that the A-10 outshines its competitors, mainly because it is the only modern aircraft built for the attack role. It was purposely designed and constructed to offer unprecedented ground support with special considerations to protect it from battle damage while performing low-altitude missions. For example, despite lacking a radar warning receiver system, it stands out by being the only aircraft completely operational from a dirt runway. Demands for CAS in Iraq and Afghanistan kept the A-10 as a relevant platform requiring upgrades, so a service life extension program was completed to rebuild and strengthen wing and structural components in order to "safely and effectively fly the A-10 to 16,000 flying hours or beyond 2028."[82] Additionally, C-model upgrades to avionics components and a $1.6 billion contract to modernize and sustain precision engagement and parts availability through Thunderbolt Lifecycle Program Support Prime Integration give the A-10 logistics support comparable to that of newer airframes.[83] Although the F-35 represents the latest technology and potential capability, being a multirole platform constrains its effectiveness, and its main feature (stealth capabilities) becomes impaired during heavy-loaded CAS operations.

Given the ever-present need for CAS on today's battlefield, the Air Force needs to keep the A-10. Phasing out an entire mission design series that outperforms its competition in close-quarters air support prematurely retires an unmatched CAS capability that is available for more than a decade. Supporting the phaseout of the A-10 with a multirole next-generation fighter that has yet to be field tested is a bad idea; the F-35's statistics and specifications prove it is a mediocre CAS option compared to other multirole fighters—and it comes with a $400 billion price tag. The Air Force would be better served to reinvest 1 percent of what is being spent on the F-35 program to keep the A-10, especially after recently reinvesting millions of dollars to upgrade its service life and improve performance. It would also be prudent to purchase LAAs to reduce the overall operating costs of daily CAS coverage during war; an acquisition program with the appropriate budgeting would end up paying for itself. Furthermore, although they are aged compared to the F-35, the F-16 and F-15E continue to perform well in the multirole arena, justifying yet again the procurement of fewer F-35s.

The best aircraft for CAS in the Air Force is not a multirole fighter. CAS is better provided by a specialized aircraft with a mix of other specialized and multipurpose aircraft to support operations. At present, the best aircraft for CAS is the A-10. From a financial perspective, it does not make sense to retire this airframe after investing so much money to upgrade it to sustain operations for the next 14 years—especially since the same mission will cost nearly three times as much when performed by an F-35.

If the United States wants to continue to dominate the skies, it will need several unique aircraft to perform particular tasks as well as pilots who continue to be proficient in those specialties. Reducing overall capability and settling on newer "jack-of-all-trades" aircraft only restricts a commander's ability to complete the mission. By reducing capability, the Air Force leaves itself (and the Soldiers, Sailors, and Marines it supports) vulnerable to degraded functionality—a potentially lethal scenario

when it comes to supporting ground combat operations and effectively avoiding collateral damage. ✪

Notes

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Nuclear Deterrence in Cyber-ia

Challenges and Controversies©

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The information age has arrived, including in military affairs, but theory and policy related to nuclear deterrence are racing to keep up with a cyber-driven world. Future military conflicts, including those involving the exercise of nuclear deterrence and crisis management, will include a digital aspect. Information or "cyber" warfare is here although it is not the driver of every conflict. It exists in the foreground of any attacks against the enemy's brain and central nervous system of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR).[1] On the other hand, far too often nuclear deterrence and cyber warfare issues are treated as separate and distinct challenges. This cyber-nuclear separatism is understandable as a matter of division of labor among experts, but it casts a shadow over the reality of nuclear deterrence or crisis management under cyber-intensive conditions.

This article first examines some of the broader theoretical implications of the nuclear-cyber nexus for students of national security policy and warfare. Second, it focuses specifically on American and Russian strategic nuclear deterrence and arms control as policy-related settings for nuclear and cyber relationships. Third, it analyzes how the combination of nuclear and cyber attacks might at least hypothetically affect the stability of nuclear deterrence. Finally, the article draws pertinent conclusions about the nuclear-cyber interface insofar as it might pertain to future arms control, nonproliferation, and deterrence.

How Far Apart?

What are the implications of potential overlap between concepts or practices for cyber war and for nuclear deterrence?[2] Cyber war and nuclear weapons seem worlds apart. Cyber weapons should appeal to those who prefer a nonnuclear military-technical arc of development. War in the digital domain offers, at least in theory, a possible means of crippling or disabling enemy assets without the need for kinetic attack or of minimizing physical destruction.[3] Nuclear weapons, though, are the very epitome of "mass" destruction—so much so that their use for deterrence or the

avoidance of war by the manipulation of risk is preferred to their actual firing. Unfortunately, neither nuclear deterrence nor cyber war will be able to live in distinct policy universes for the near or distant future.

Nuclear weapons, whether held back for deterrence or fired in anger, must be incorporated into systems for C4ISR. The weapons and their C4ISR systems must be protected from attacks both kinetic and digital in nature. In addition, decision makers who have to manage nuclear forces during a crisis should ideally have the best possible information about the status of their own nuclear and cyber forces and command systems, about the forces and C4ISR of possible attackers, and about the probable intentions and risk acceptance of possible opponents. In short, the task of managing a nuclear crisis demands clear thinking and good information. But the employment of cyber weapons in the early stages of a crisis could impede clear assessment by creating confusion in networks and the action channels that depend on those networks.[4] The temptation for early cyber preemption might "succeed" to the point at which nuclear crisis management becomes weaker instead of stronger. As Andrew Futter has noted,

> With US and Russian forces ready to be used within minutes and even seconds of receiving the order, the possibility that weapons might be used by accident (such as the belief that an attack was underway due to spoofed early warning or false launch commands), by miscalculation (by compromised communications, or through unintended escalation), or by people without proper authorization (such as a terrorist group, third party or a rogue commander) is growing. Consequently, in this new nuclear environment, it is becoming progressively important to secure nuclear forces and associated computer systems against cyber attack, guard against nefarious outside influence and "hacking," and perhaps most crucially, to increase the time it takes and the conditions that must be met before nuclear weapons can be launched.[5]

Ironically, the downsizing of US and post-Soviet Russian strategic nuclear arsenals since the end of the Cold War, although a positive development from the perspectives of nuclear arms control and nonproliferation, makes the concurrence of cyber and nuclear attack capabilities more alarming. The enormous and redundant deployments by the Cold War Americans and Soviets had at least one virtue. Those arsenals provided so much redundancy against first-strike vulnerability that relatively linear systems for nuclear attack warning, command and control (C2), and responsive launch under—or after—attack sufficed. At the same time, Cold War tools for military cyber mischief were primitive compared to those available now. In addition, countries and their armed forces were less dependent on the fidelity of their information systems for national security. Thus, the reduction of US, Russian, and possibly other forces to the size of "minimum deterrents" might compromise nuclear flexibility and resilience in the face of kinetic attacks preceded or accompanied by cyber war.[6] For example, Bruce Blair, nuclear policy expert and author of a number of studies on nuclear C2, has observed that

> the communications and computer networks used to control nuclear forces are supposed to be firewalled against the two dozen nations (including Russia, China and North Korea) with dedicated computer-attack programs and from the thousands of hostile intrusion attempts made every day against U.S. military computers. But investigations into these firewalls have revealed glaring weaknesses.[7]

The preceding discussion does acknowledge that "nuclear-" and "cyber-related" theories, as well as derivative policy prescriptions, have unique attributes and warning signs against facile analogies. Nevertheless, the cyber "domain" cuts across the other geostrategic domains for warfare: land, sea, air, and space. On the other hand, the cyber domain, compared to the others, suffers from the lack of a historical perspective: the cyber domain "has been created in a short time and has not had the same level of scrutiny as other battle domains," as Maj Clifford S. Magee, USMC, has argued.[8] Brian M. Mazanec also points out the "relative secrecy surrounding most cyber operations with no extensive record of customary practices of states."[9] James Wood Forsyth Jr. and Maj Billy E. Pope emphasize that cyberspace has enabled "a new form of war that no one can see, measure, or presumably fear."[10] However, experts also expect that since we are in the early stages of cyber conflict, we can anticipate that more numerous and more sophisticated cyber weapons will be developed and integrated into states' national military strategies and operational planning guidance. As Mazanec has argued,

> Thus, cyberwarfare capabilities will play an increasingly decisive role in military conflicts and are becoming deeply integrated into states' doctrine and military capabilities. Over 30 countries have taken steps to incorporate cyberwarfare capabilities into their military planning and organizations, and the use of cyberwarfare as a "brute force" weapon is likely to increase. Military planners are actively seeking to incorporate offensive cyber capabilities into existing war plans, which could lead to offensive cyber operations playing an increasingly decisive role in military operations at the tactical, operational, and strategic levels.[11]

Table 1 summarizes information about some of the more publicized computer network attacks (CNA) between 2007 and 2013.

Table 1. Selected computer network attacks

Attack Name	Date	Target	Effect	Suspected Perpetrator
Estonia	April–May 2007	Commercial and governmental web services (civilian target)	Major distributed denial of service (DDOS) attack	Russia
Syrian air defense system (part of Operation Orchard)	September 2007	Military air defense system (military target)	Degradation of air defense capabilities allowing kinetic strike	Israel
Georgia	July 2008	Commercial and governmental web services (civilian target)	Major DDOS attack	Russia
Stuxnet	Late 2009–10, possibly as early as 2007	Iranian centrifuges (military target)	Physical destruction of Iranian centrifuges	United States
Saudi Aramco	August 2012	State-owned commercial enterprise (civilian target)	Large-scale destruction of data and attempted physical disruption of oil production	Iran
Operation Ababil	September 2012– March 2013	Large US financial institutions (civilian target)	Major DDOS attack	Iran

Adapted from Brian M. Mazanec, "Why International Order in Cyberspace Is Not Inevitable," *Strategic Studies Quarterly* 9, no. 2 (Summer 2015): 81, http://www.au.af.mil/au/ssq/digital/pdf/summer_2015/SSQ_Summer_2015.pdf. CNAs include computer network exploitation.

Of course, CNAs are not the only cyber threat posed by potential US adversaries or other state or nonstate actors. According to Joel Brenner, former inspector general and former senior counsel at the National Security Agency,

> The U.S. Navy spent about $5 billion to develop a quiet electric drive for its submarines and ships so they'd be silent and hard to track. Chinese spies stole it. The navy spent billions more to develop new radar for their top-of-the-line Aegis Cruiser. Chinese spies stole that, too. The electronic intelligence services of the Chinese and the Russians are working us over—taking advantage of our porous networks and indifference to security to steal billions of dollars' worth of military and commercial secrets. Some of our allies, like the French and the Israelis, have tried it too.[12]

Brenner asserts that the United States' military-industrial complex "is the world's fattest espionage target" and that more than 100 foreign intelligence services target the United States.[13] As a reminder of this horse race between cyber attackers and defenders, the US government reported large attacks by Russian hackers against the Internal Revenue Service and by Chinese hackers against the majority of US federal agencies during the first week of June 2015.[14]

Notwithstanding the significance of cyber-related challenges to US national security, it does not necessarily follow that deterrence concepts or methods will be applicable to cyberspace. As Dorothy E. Denning notes, authors comparing nuclear deterrence to cyber deterrence "have generally found that the principles that have made nuclear deterrence effective for over half a century fall apart in cyberspace."[15] She cautions that "just as we do not sweep all physical weapons into a single strategy of deterrence, we should not try to sweep all cyber weapons into a single strategy. Rather, we need to narrow our treatment of deterrence as it relates to cyberspace."[16]

Denning suggests two possible approaches to the application of deterrence to cyberspace. The first involves focusing on specific types of cyber weapons for which deterrence might be feasible, such as nuclear electromagnetic pulse weapons. A second approach to deterrence in cyberspace, according to Denning, might be the application of existing deterrence regimes to some cyber activities, including international regimes governing states' behavior or domestic regimes dealing with criminal behavior.[17] Table 2 summarizes some of the major genetic markers that set unique identities for cyber war and nuclear deterrence, even as they are pushed closer together by technology creep, by the demands of policy and strategy, and by international rivalry.

Table 2. Comparative attributes of cyber war and nuclear deterrence

Cyber War	Nuclear Deterrence
The source of attack may be ambiguous—third-party intrusions masquerading as other actors are possible.	The source of attack is almost certain to be identified if the attacker is a state, and even terrorist attackers' nuclear materials may be traceable.
Damage is mostly to information systems, networks, and their messaging contents although these might have spillover effects to the operations of military combat systems, economy, and social infrastructure. (Stuxnet was an exceptional, purpose-built destroyer of targeted nuclear facilities.)	Failure of deterrence can lead to historically unprecedented and socially catastrophic damage even in the case of a "limited" nuclear war by Cold War standards.

Table 2 *(continued)*

Denial of the attacker's objectives is feasible if defenses are sufficiently robust and/or penetrations can be repaired in good time.	Deterrence by means of threat to deny the attacker its objectives is less credible than the threat of punishment by assured retaliation (although improved missile defenses seek to change this scenario).
The objective of cyber attacks is typically disruption or confusion rather than destruction per se.	Nuclear deterrence has rested for the most part on the credible threat of massive, prompt destruction of physical assets and populations.
Cyber war and information attacks can continue over an extended period of time without being detected and sometimes without doing obvious or significant damage—some are not even reported after having been detected.	The first use of a nuclear weapon since 1945 by a state or nonstate actor for a hostile purpose (other than a test) would be a game-changing event in world politics, regardless of the size of the explosion and the immediate consequences.
The price of entry to the games table for cyber war is comparatively low—actors from individual hackers to state entities can play.	Building and operating a second-strike nuclear deterrent requires a state-supported infrastructure, scientific and technical expertise on a large scale, and long-term financial commitments.

Sources: Author. See also Dorothy E. Denning, "Rethinking the Cyber Domain and Deterrence," *Joint Force Quarterly* 77 (2nd Quarter 2015): 8–15, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-77/jfq-77_8-15_Denning.pdf; Edward Geist, "Deterrence Stability in the Cyber Age," *Strategic Studies Quarterly* 9, no. 4 (Winter 2015): 44-61; Timothy L. Thomas, *Three Faces of the Cyber Dragon: Cyber Peace Activist, Spook, Attacker* (Fort Leavenworth, KS: Foreign Military Studies Institute, 2012), 60–66; Martin C. Libicki, *Crisis and Escalation in Cyberspace* (Santa Monica, CA: RAND Corporation, 2012); and Libicki, *Cyberdeterrence and Cyberwar* (Santa Monica, CA: RAND Corporation, 2009).

Cyber and Nuclear Crisis Management

Since nuclear weapons are deployed primarily for the purpose of avoiding war by means of deterrence, the relationship between evolving forms of cyber or information warfare and nuclear crisis management becomes an important agenda item for analysts and military planners. Either information or cyber warfare has the potential to attack or to disrupt successful crisis management on each of four important attributes.[18] First, information warfare can muddy the signals being sent from one side to the other in a crisis. This deception can be done deliberately or inadvertently. Suppose one side plants a virus or worm in the other's communications networks.[19] The virus or worm becomes activated during the crisis and destroys or alters information. The missing or altered information may make it more difficult for the cyber victim to arrange a military attack. But destroyed or altered information may mislead either side into thinking that its signal has been correctly interpreted when in fact it has not. Thus, side A may intend to signal "resolve" instead of "yield" to its opponent on a particular issue. Side B, misperceiving a "yield" message, may decide to continue its aggression, meeting unexpected resistance and causing a much more dangerous situation to develop.

Information warfare can also destroy or disrupt communication channels necessary for successful crisis management. It can do so by disrupting communication links between policy makers and military commanders during a period of high threat and severe time pressure. Two kinds of unanticipated problems, from the standpoint of civil-military relations, are possible under these conditions. First, political leaders may have predelegated limited authority for nuclear release or

launch under restrictive conditions: only when these few conditions obtain, according to the protocols of predelegation, would military commanders be authorized to employ nuclear weapons distributed within their command. Clogged, destroyed, or disrupted communications could prevent top leaders from knowing that military commanders perceived a situation to be far more desperate—and thus permissive of nuclear initiative—than it really was. For example, during the Cold War, disrupted communications between the US president and secretary of defense and ballistic missile submarines, once the latter came under attack, could have resulted in a joint decision by submarine officers and crew to launch in the absence of contrary instructions.

Second, information warfare during a crisis will almost certainly increase the time pressure under which political leaders operate. It may do so literally, or it may affect the perceived time lines within which the policy-making process can make its decisions. Once either side sees parts of its command, control, and communications system being subverted by phony information or extraneous cyber noise, its sense of panic at the possible loss of military options will be enormous. In the case of US Cold War nuclear war plans, for example, disruption of even portions of the strategic command, control, and communications system could have prevented competent execution of parts of the Single Integrated Operational Plan (the strategic nuclear war plan). The plan depended upon finely orchestrated time-on-target estimates and precise damage expectancies against various classes of targets. Partially misinformed or disinformed networks and communications centers would have led to redundant attacks against the same target sets and, quite possibly, unplanned attacks on friendly military or civilian installations.

A third potentially disruptive effect of information warfare on nuclear crisis management is that such warfare may reduce the search for available alternatives to the few and desperate. Policy makers searching for escapes from crisis denouements need flexible options and creative problem solving. Victims of information warfare may have a diminished ability to solve problems routinely, let alone creatively, once information networks are filled with flotsam and jetsam. Questions to operators will be poorly posed, and responses (if available at all) will be driven toward the least common denominator of previously programmed standard operating procedures. Retaliatory systems that depend on launch-on-warning instead of survival after riding out an attack are especially vulnerable to reduced time cycles and restricted alternatives.

The propensity to search for the first available alternative that meets minimum satisfactory conditions of goal attainment is strong enough under normal conditions in nonmilitary bureaucratic organizations.[20] In civil-military C2 systems under the stress of nuclear crisis decision making, the first available alternative may quite literally be the last—or so policy makers and their military advisers may persuade themselves. Accordingly, the bias toward prompt and adequate solutions is strong. During the Cuban missile crisis, for example, a number of members of the presidential advisory group continued to propound an air strike and invasion of Cuba during the entire 13 days of crisis deliberation. Had less time been available for debate and had President Kennedy not deliberately structured the discussion in a way

that forced alternatives to the surface, the air strike and invasion might well have been the chosen alternative.

Fourth—and finally on the issue of crisis management—information warfare can cause flawed images of each side's intentions and capabilities to be conveyed to the other, with potentially disastrous results. Another example from the Cuban missile crisis demonstrates the possible side effects of simple misunderstanding and non-communication on US crisis management. At the tensest period of the crisis, a U-2 reconnaissance aircraft got off course and strayed into Soviet airspace. US and Soviet fighters scrambled, and a possible Arctic confrontation of air forces loomed. Khrushchev later told Kennedy that Soviet air defenses might have interpreted the U-2 flight as a prestrike reconnaissance mission or as a bomber, calling for a compensatory response by Moscow.[21] Fortunately, the Soviet leadership chose to give the United States the benefit of the doubt in this instance and to permit US fighters to escort the wayward U-2 back to Alaska. Why this scheduled U-2 mission was not scrubbed once the crisis began has never been fully revealed; the answer may be as simple as bureaucratic inertia compounded by noncommunication down the chain of command by policy makers who failed to appreciate the risk of "normal" reconnaissance under these extraordinary conditions.

The preceding discussion and examples are underscored by the assessment of expert analyst Martin Libicki regarding the relationship between cyber war and crisis management:

> To generalize, a situation in which there is little pressure to respond quickly, in which a temporary disadvantage or loss is tolerable, and in which there are grounds for giving the other side some benefit of the doubt is one in which there is time for crisis management to work. Conversely, if the failure to respond quickly causes a state's position to erode, a temporary disadvantage or degree of loss is intolerable, and there are no grounds for disputing what happened, who did it, and why—then states may conclude that they must bring matters to a head quickly.[22]

This overview of the possible dysfunctions in nuclear crisis management when it overlaps with cyber war is not necessarily totally pessimistic. Human beings remain in charge, not computers and information networks. If those human beings bring to the table an awareness of human fallibility, an appreciation of historical precedent, and a clear sense of proportion about the use of technology in times of peace, crisis, and war, they have every chance for success. On the other hand, decision makers who are overconfident of their abilities, unaware of historical precedents, and besotted with technical hubris or military systems for their own sake can accomplish a considerable amount of mayhem in a very short time.

Conclusions

Cyber tools will not obviate the need for nuclear deterrence, and analytical models designed for the study of nuclear deterrence cannot be transferred directly into the realm of cyber conflict without creating paradigm pandemonium. Military planners and policy makers, however, will find points of intersection between nuclear and cyber problems. The issue of truly "strategic" cyber war apart from kinetic attacks poses a less imminent concern than does cyber as an enabler (or disabler) of suc-

cess in conventional war or nuclear deterrence. The future of digital technology as it applies to military affairs is a magical mystery tour of unknowns. But a safe wager is that future nuclear C2 and communications systems, however driven by digital improvements, will nevertheless have to satisfy the policy and strategy requirements for prompt response to authorized commands, for avoidance of false positives in early warning and reaction, and for maintenance of a spectrum of viable options for policy makers and commanders, even under the duress of war or of imminent threat of war.

The relationship between nuclear crisis management and the information age is a work in progress, but several potential ambushes for nuclear deterrence and crisis stability can be identified now. First, cyber war or software malfunctions might interfere with reliable communication. Second, cyber attacks might take place more rapidly than decision makers could interpret the results and/or resolve upon an appropriate response. Third, the identity of a cyber attacker might remain unclear for the duration of a crisis; indeed, a third party could "impersonate" an American or Russian communication or create an information embolism in either state's networks. In an extreme case, a state-directed hacker or individual malware malcontent might trigger an incorrect attack warning or trigger an inauthentic launch command. Furthermore, even if we assume that current and prospective US and Russian nuclear systems are proof against mistaken warnings or accidental launches, the vulnerability of other states' nuclear C2 and launch systems to cyber war is unknown. ✪

Notes

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2. US defense strategy defines three primary Department of Defense (DOD) cyber missions: defense of DOD networks, systems, and information; defense of the US homeland and national interests against cyber attacks of significant consequence; and cyber support for military operations and contingency plans. See US Department of Defense, *The DOD Cyber Strategy* (Washington, DC: US Department of Defense, April 2015), esp. 4–6, http://www.defense.gov/Portals/1/features/2015/0415_cyber-strategy /Final_2015_DoD_CYBER_STRATEGY_for_web.pdf. See also Cheryl Pellerin, "DARPA's Plan X Gives Military Operators a Place to Wage Cyber Warfare," US Department of Defense, 12 May 2016, http:// www.defense.gov/News-Article-View/Article/758219/darpas-plan-x-gives-military-operators-a-place-to -wage-cyber-warfare; Edward Geist, "Deterrence Stability in the Cyber Age," *Strategic Studies Quarterly* 9, no. 4 (Winter 2015): 44–61; Robert Spalding III and Adam Lowther, "The New MAD World: A Cold War Strategy for Cyberwar," *National Interest*, 22 June 2015, http://nationalinterest.org/feature/the -new-mad-world-cold-war-strategy-cyberwar-13154; Singer and Friedman, *Cybersecurity and Cyberwar*; Colin S. Gray, *Making Strategic Sense of Cyber Power: Why the Sky Is Not Falling* (Carlisle, PA: Strategic Studies Institute, US Army War College, April 2013); Martin C. Libicki, *Crisis and Escalation in Cyber-space* (Santa Monica, CA: RAND Corporation, 2012); Kamaal T. Jabbour and E. Paul Ratazzi, "Does the United States Need a New Model for Cyber Deterrence?," chap. 3 in *Deterrence: Rising Powers, Rogue Regimes, and Terrorism in the Twenty-First Century*, ed. Adam B. Lowther (New York: Palgrave Macmillan, 2012), 33–45; and Martin C. Libicki, *Cyberdeterrence and Cyberwar* (Santa Monica, CA: RAND, 2009).

3. The "Stuxnet" virus is a contrarian example since it was specifically designed and intended for the destruction of nuclear centrifuges in Iran. See Singer and Friedman, *Cybersecurity and Cyberwar*, esp. 114–20. On the information operations concepts of major powers, see Timothy L. Thomas, *Cyber Silhouettes: Shadows over Information Operations* (Fort Leavenworth, KS: Foreign Military Studies Office, 2005), chaps. 5–6, 10, 14, and passim. See also Pavel Koshkin, "Are Cyberwars between Major Powers

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4. Cyber weapons are not necessarily easy to use effectively as enabling instruments for operational/ tactical or strategic effect. See Martin C. Libicki, *Conquest in Cyberspace: National Security and Information Warfare* (New York: Cambridge University Press, 2007), esp. chaps. 4–5.

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6. An expert critique of proposals for minimum deterrence for US nuclear forces appears in Dr. Keith B. Payne, study director, and Hon. James Schlesinger, chairman, Senior Review Group, *Minimum Deterrence: Examining the Evidence* (Fairfax, VA: National Institute for Public Policy, National Institute Press, 2013). For a favorable expert assessment of the prospects for minimum deterrence, see James Wood Forsyth Jr.; Col B. Chance Saltzman, USAF; and Gary Schaub Jr., "Remembrance of Things Past: The Enduring Value of Nuclear Weapons," *Strategic Studies Quarterly* 4, no. 1 (Spring 2010): 74–90.

7. Bruce Blair, "Could Terrorists Launch America's Nuclear Missiles?," *Time*, 11 November 2010, http://content.time.com/time/nation/article/0,8599,2030685,00.html. One reviewer for this article objected to Blair's argument as quoted, responding that his assessment was "patently false."

8. Maj Clifford S. Magee, USMC, "Awaiting Cyber 9/11," *Joint Force Quarterly* issue 70 (3rd Quarter 2013): 76, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-70/JFQ-70_76-82_Magee.pdf.

9. Brian M. Mazanec, "Why International Order in Cyberspace Is Not Inevitable," *Strategic Studies Quarterly* 9, no. 2 (Summer 2015): 80, http://www.au.af.mil/au/ssq/digital/pdf/summer_2015/SSQ _Summer_2015.pdf.

10. James Wood Forsyth Jr. and Maj Billy E. Pope, USAF, "Structural Causes and Cyber Effects: Why International Order Is Inevitable in Cyberspace," *Strategic Studies Quarterly* 8, no. 4 (Winter 2014): 118, http://www.au.af.mil/au/ssq/digital/pdf/winter_14/forsyth.pdf. See also Mazanec, "International Order in Cyberspace," 96. The issue of whether cyber is a "domain" or something else is an epistemological debate not entered into here.

11. Mazanec, "International Order in Cyberspace," 83.

12. Joel Brenner, *Glass Houses: Privacy, Secrecy, and Cyber Insecurity in a Transparent World* (New York: Penguin Books, 2013), 3.

13. Ibid., 73.

14. David E. Sanger and Julie Hirschfield Davis, "Hacking Linked to China Exposes Millions of U.S. Workers," *New York Times*, 4 June 2015, http://www.nytimes.com/2015/06/05/us/breach-in-a-federal -computer-system-exposes-personnel-data.html; and Chris Frates, "IRS Believes Massive Data Theft Originated in Russia," *CNN*, 4 June 2015, http://www.cnn.com/2015/05/27/politics/irs-cyber-breach -russia/.

15. Dorothy E. Denning, "Rethinking the Cyber Domain and Deterrence," *Joint Force Quarterly* 77 (2nd Quarter 2015): 11, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-77/jfq-77_8-15_Denning.pdf.

16. Ibid., 12.

17. Ibid., 13–15.

18. For useful definitions of *cyber attack* and *cyber war*, see Paul K. Davis, "Deterrence, Influence, Cyber Attack, and Cyberwar," *International Law and Politics* 47 (2015): 327–55, esp. 328.

19. A virus is a self-replicating program intended to destroy or alter the contents of other files stored on floppy disks or hard drives. Worms corrupt the integrity of software and information systems from the "inside out" in ways that create weaknesses exploitable by an enemy.

20. James G. March and Herbert A. Simon, *Organizations* (New York: John Wiley and Sons, 1958), 140, 146.

21. Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis* (Boston: Little, Brown, 1971), 141. See also Scott D. Sagan, *Moving Targets: Nuclear Strategy and National Security* (Princeton, NJ: Princeton University Press, 1989), 147.

22. Libicki, *Crisis and Escalation in Cyberspace*, 145.
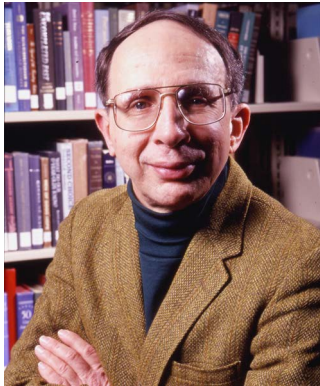
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The Russian Perception of the NATO Aerospace Threat

Could It Lead to Preemption?

Lt Col Thomas R. McCabe, USAFR, Retired

A major shift occurred in the geopolitical/geostrategic landscape in Europe well before the United Kingdom's vote to leave the European Union. Russia's forcible annexation of the Crimean region of Ukraine and its recent assertive military moves, especially in the Baltic area, have led to the most serious crisis in Russian-American/Western relations since the end of the Cold War. So far, no one has suggested a plausible strategy for reversing the annexation of Crimea by Russian president Vladimir Putin or, for that matter, for preventing further Russian encroachments on Ukraine.[1] No one has proposed a forcible military counteraction (neither the United States nor the North Atlantic Treaty Organization [NATO] has a specific commitment to defend Ukraine in any case). In fact, so far neither the Obama administration nor the major European countries have been willing to provide serious military aid to Ukraine. There is absolutely no sign that President Putin considers the costs of economic and other sanctions imposed by the West on Russia as especially problematic.

The obvious question, especially for Eastern Europe, is whether Ukraine is the first step in a new Russian strategy that seeks, among other things, to absorb areas inhabited by ethnic Russians in neighboring states into the Russian Federation. It is all too plausible that President Putin, as a Russian nationalist, ultimately intends to rebuild the Russian Empire.[2] Furthermore, he appears to have devised a so-far-effective strategy and set of tactics for doing so—"ambiguous warfare" (waging war with deniable forces intended to keep the war below the threshold that might trigger outside intervention).[3] Russia's foreign policy concept calls for protecting the rights and legitimate interests of Russian speakers living outside Russia. However blandly or legalistically phrased, such a policy—under current circumstances—must fill with apprehension Russia's western neighbors who have significant or large ethnic Russian populations.[4] A further danger is that if the West cannot devise an effective policy, other potentially predatory powers will take note and act.[5] This situation has the potential for becoming a 1931 Manchurian moment, during which the Japanese army invaded and occupied Manchuria, establishing the puppet state of Manchukuo.

The Western powers did nothing other than protest. This event established the precedent that predatory powers could redraw borders by force.

Clearly, the days when the United States and the West could tell themselves that Russia is not an adversary are over. Believing that the United States intends to destabilize Russia and dominate the world, President Putin undoubtedly reached that conclusion a long time ago and has evidently decided that it is more advantageous to be confrontational with the United States and Europe than cooperative.[6] Russia has obviously adopted an assertive policy of saber rattling against its European neighbors, as shown by—among other things—its continuing military buildup, recently expanded air operations, and training exercises in the region.[7] The Great Power peace that has more or less prevailed in Europe since the end of the Cold War may well be over. Now what?

The United States and the rest of NATO have started taking a higher military profile in Eastern Europe. Among other steps, the recent NATO summit in Warsaw has approved the forward deployment of four battalions under American, British, Canadian, and German command in Estonia, Latvia, Lithuania, and Poland.[8] Given the dismal likelihood that these actions are becoming or will become a systemic confrontation, it is time to consider what else might serve to deter further Russian adventurism, especially military threats against NATO's eastern members.[9] A review of Russian military writings identifies a threat that the Russians take very seriously: that of American and Western conventional airpower.

Modern Air and Space Warfare: The Russian View

Using terms that frequently parallel US Air Force thinking on the subject, since at least the turn of the twenty-first century, authoritative Russian military writings and spokesmen have repeatedly declared that the aerospace sphere, where air and space combine into a single region of armed conflict with no distinct border between the two, is emerging as one of the main—if not *the* main—centers of warfare, especially among developed states.[10] These Russian experts believe that the side with aerospace superiority will have the initiative in any such wars and that ensuring superiority over the enemy in the aerospace field will be a necessary condition for achieving the objectives of the war.[11] They evaluate that the large-scale outfitting of air forces with high-precision weapons and the qualitative improvement in aircraft; air weapons; and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) and electronic warfare systems in recent decades have had a profound impact on air warfare, with the following results:

- The air war may be fought over a larger geographic area than previously due to the longer range of weapons and the increased scope of missions performed by aviation.[12]

- Massed air-missile strikes (i.e., strikes by a combination of aircraft and missiles) now constitute the foundation of offensive air operations.[13] A massed air-missile strike will now consist of simultaneous operations using a large number of smaller air elements—sometimes single aircraft—attacking numerous targets

rather than one massive air-missile strike against a single target.[14] This dispersed threat will be more difficult to detect and to stop, especially in the case of Russia because of the country's geographical features such as long borders, remote areas, and the isolated exclave of Kaliningrad on the Baltic Sea.[15]

- The increased intensity of combat operations has drastically reduced the time needed to execute combat missions "from several hours to a few minutes."[16]

- "Manifold" growth has occurred in the importance of intelligence, command and control (C2), and information operations.[17] Such operations will involve an integrated, network-centric global C4ISR system with extensive use of space systems to provide intelligence, navigation, and communication support to air operations.[18]

- Growth in the combat potential of air groupings increases the opportunity for tactical surprise, especially in delivering the first air strikes. Specifically, combat operations can start using peacetime deployments without reinforcements, as happened during Operation Desert Fox against Iraq in 1998, and because high-precision weapons can be launched from outside zones monitored by the warning ("information") assets of the defending side.[19]

- The use of unmanned weapons, especially cruise missiles, has increased.[20]

- Air attacks can be increasingly flexible because of enhanced real-time modification of aircraft and cruise missile attacks en route to the target.[21]

- Electronic warfare will be closely integrated into air operations and will seek not only tactical advantage but also suppression of entire military and political C2 systems, as well as the disruption of economies and societies.[22]

From the Russian perspective, these improvements mean a massive—and constantly increasing (but very exaggerated, this analysis argues)—conventional air threat to Russia. For instance, in 2012 the Russians estimated that in a large-scale war, the Moscow area Central Industrial Region alone would be attacked by 1,500 combat aircraft and 1,000 cruise missiles.[23] The West's huge force of air- and sea-launched cruise missiles (typical Russian figure from 2014—7,000 missiles) is expected to be the predominant weapon in any massed air-missile attack and is considered particularly threatening.[24] Sometimes these missiles have been estimated to pose an especially dangerous threat to Russian strategic nuclear forces—witness the Russians quoting supposed US projections that America can neutralize 80–90 percent of Russian strategic nuclear deterrence forces.[25]

The Threat: The Western Air Campaign and Its Air Operations

In one of the most comprehensive discussions to date, the late General of the Army Anatoly Kornukov, then commander in chief of the Russian Air Forces (RuAF), declared in 2001 that *air campaigns* and *air operations* were and would continue to be the main forms of the employment of foreign air combat power in military conflicts.[26] Russian writings define these terms as follows:

- An *air campaign* is the sum of several interrelated air operations, united by a common concept of operations and directed at achieving important strategic goals.

- An *air operation* is the coordinated and concentrated combat operations of joint and combined formations and units, primarily air force and navy strike forces of cruise missiles and aircraft. In these the various types of aviation and air defense forces operate jointly and under single leadership to achieve specific goals.[27]

Authoritative Russian military writings expect an air campaign, at its most ambitious, to be part of a larger effort that combines military and nonmilitary efforts (especially comprehensive subversion by information operations, special operations forces, and intelligence agencies) to destabilize a government and foment regime change, as those writings claim NATO did in Libya.[28] (In 2013 General of the Army Valery Gerasimov, chief of the Russian General Staff, claimed that the Arab Spring was actually "typical of 21st Century warfare" [i.e., it was neither internal nor spontaneous].)[29] Such an effort aimed at Russia will intend to attain decisive strategic or operational-strategic objectives, such as forcing Russia to accept the terms of a dictated peace, fomenting regime change in that country through a "color revolution" (a more-or-less peaceful uprising from below that overthrows a dictatorship in the name of democracy, such as happened in the "Orange Revolution" in Ukraine in 2004), or even dismembering the Russian Federation.[30] An air campaign may also be used in a more limited regional war, as was the case with Iraq in 1991.

The air campaign will be a joint operation with coordinated objectives conducted according to a single concept and plan. It will consist of air operations involving integrated actions by offensive, defensive, and support forces. The campaign may include a space operation to ensure control of that medium and unhindered use of space systems, as well as an electronic operation using electronic warfare and cyberwar to administer an "electronic knockdown."[31] It may be waged by large combined-arms strategic formations, with air forces predominant, or as an independent operation by air forces alone. These operations will conduct integrated and comprehensive precision strikes against military, political, and economic targets throughout the entire area of a theater of military operations, theater of war, or country.[32] They will be conducted using specially organized reconnaissance and strike weapons systems, the foundation of which will be space-based surveillance, navigation, and targeting systems, together with air- and sea-based standoff precision weapons systems.[33] The campaign may involve clandestine raids by special operations forces seeking to identify targets before air or missile strikes by stealth aircraft, Tomahawk-carrying nuclear submarines, and other advanced weapon systems.[34] Instead of concentrating on one axis of attack ("strategic axis"), attacking weapons are expected to be spread over multiple axes.[35]

Russian military experts believe that an air campaign targeting Russia will try to establish air supremacy by neutralizing its air and space capability, especially its airfields, aircraft, and aerospace defenses.[36] Another key objective, as previously noted, may be a disarming strike with conventional weapons against Russian strategic nuclear forces, a strike that may last only "dozens of minutes."[37] Additional major objectives may include the following:

- disrupting state [national government] and military command and control;[38]

- disrupting mobilization and operational and strategic transportation;[39] and

- inflicting strategic damage on key military and civilian production complexes—the most vulnerable and potentially the most critical targets.[40] Doing so will undermine the country's economy as a whole, as the Russians believe happened in the NATO air campaign against Yugoslavia.[41]

The enemy may even count on attaining his ultimate military objectives without major destruction of military personnel or the rout of Russia's main military forces—and without committing ground forces or seizing or holding large tracts of territory, as was the case in NATO's operation against Yugoslavia.[42]

Russian military writings expect that in any NATO air campaign against Russia, a series of offensive air operations ("air offensives" such as the opening phases of the 1991 war against Iraq) will be central. These air offensives will pursue their objectives mainly by attacking targets on the ground and possibly at sea, combined with conducting active space warfare.

Extrapolating from past operations and assertions about unspecified NATO exercises, Russian writings estimate that NATO's primary air bases are within 400–600 kilometers of the Russian Federation's national border.[43] They expect that NATO will have full access to the Baltic states' supposedly extensive infrastructure for forward staging for the conduct of an air offensive and that NATO will have created adequate logistics support reserves to support aircraft operations. From these bases, they assess that NATO's tactical aviation is capable of attacking Russian and Russian-allied Belarusian armed forces throughout all of Belarus and western Russia.[44] These writings project two primary variants for the opening of the air campaign:

1. Staging through forward bases. The first massed attack ("air-missile strike") will be conducted with the attacking aircraft taking off from their permanent bases well to the rear. After the initial air-missile strike, they will land to refuel and rearm at the airfields of the Eastern European countries and the Baltic States, conduct a second massed attack, and then return to their permanent bases to prepare for subsequent massed attacks.[45]

2. Launching from forward bases. A significant portion of the aircrews, support personnel, and equipment used to conduct the first massed attack will deploy to airfields in the Baltic States and Eastern European countries before the war. They will then conduct their massed attack from the forward airfields.[46]

The first operation of any NATO air campaign would establish air superiority, disrupt state and military C2, and fracture the deployment of armed forces. Its is expected to last five to seven days, depending on the targets, the distinctive nature of the strategic axis (in this case, the Western strategic axis), and the resulting situation.[47]

Russian analysts project that on the first day, NATO would conduct two massed air-missile strikes. Most sorties (up to 70 percent) would be allocated to gaining air superiority, with the rest allocated for air support of ground troops.[48] On the second day of air operations, Russian writers expect one or two massed aircraft-missile strikes designed to gain air superiority (up to 50 percent of sorties), provide direct

air support (up to 30 percent), and isolate the combat operations area (up to 20 percent).[49] Projections for the third day are for one massed aircraft-missile strike that would isolate the combat area (up to 70 percent) and maintain air superiority (up to 30 percent) (see the table below).[50]

Table. Projected apportionment of air-missile strikes during opening phases of first air operation

Day	Number of massed strikes	Percent air superiority	Percent support ground troops	Percent isolate battlefield
1	2	Up to 70	Up to 30	—
2	1–2	Up to 50	Up to 30	Up to 20
3	1	Up to 30	—	Up to 70

After the first offensive air operation, NATO air forces are projected to transition to what the Russians call "systematic combat operations," which are intended to carry out "suddenly or sequentially emerging missions of varying scale."[51] One of these missions would continue attacks to disrupt C2 and demoralize personnel.[52]

The conduct of subsequent air operations would be determined by the degree to which the goals of the first offensive air operation had been realized and would be coordinated with the operations of ground and naval forces. Second and subsequent air operations would have the following objectives: destroy troop concentrations in the theater of military operations, destroy communications centers and military-industrial facilities, and support ground troops.[53] The Russians project that the total air campaign against Russia would take 35–40 days.[54]

Potential Russian Responses

If Russia is threatened with or subjected to major conventional aerospace attack, Moscow is likely to perceive that it has two main options for response. If it were certain that enemy forces were about to attack the homeland, it could launch a pre-emptive strike or even a preventive war.[55] Hopefully, it will be difficult to obtain political permission to do so, but as this article later discusses, that possibility cannot be ruled out. If Russia does not preempt, the alternative is to attempt to destroy enough attackers to neutralize the effects of the attack. This action would involve what Russia defines as a defensive strategic air operation—an "air defensive" operation—during which the main, and possibly the only, effort involves engaging and defeating an enemy in the course of his air strikes.[56] During such an operation, the primary missions of the RuAF include the following:[57]

- Repelling the first surprise air-missile strike to permit the mobilization and strategic deployment of the Russian armed forces and the transition of the Russian government to a wartime footing.[58] Air defense of Russia and allied territory—especially Belarus—will be critical for absorbing and defeating the attack.[59] Forces available at the start of hostilities should conduct this defense.[60] Priority will be given to protecting nuclear retaliatory capability, the highest levels of government and military C2, economic installations, and state infrastructure.[61]

- Inflicting damage on the enemy's main body by coordinated operations of defensive forces against offensive aerospace weapons in flight (en route, on trajectories, in orbits) and against strike forces throughout the enemy's basing system, including aircraft carriers and enemy command centers inside as well as outside the area of direct conflict.[62] The Russians call this action "offensive defense."[63]

- Providing air cover and air support for defensive military operations to repel invasions by enemy land and naval forces.[64]

- Supplying air cover and air support for ground units to support their seizure of the strategic initiative by conducting defensive and counteroffensive operations.[65]

As a final deterrent, the Russians reserve the right to use nuclear weapons first if they judge that the existence of the Russian state is under threat from conventional attack.[66] Making this prospect even more ominous is that Russian military doctrine includes the concept that a limited nuclear strike can be used to force an enemy to "de-escalate" an attack.[67]

The Present and Future of Russian Air and Space Defense

Despite Russians' claims of a massive and rapidly growing threat, their efforts to counter it have actually been fairly modest. Historically, Russia (and before 1991, the Soviet Union) has put one of its highest military priorities on active defense of the homeland; furthermore, development and maintenance of an efficient and effective air, missile, and space defense force have been a key Russian military requirement.[68] However, the military and economic aftermath of the collapse of the Soviet Union had a devastating impact on Russia's military capabilities, and the country phased out many of its air and air defense systems.[69] Only as Russia's economy began recovering during the last decade has the nation started to rebuild its military, including modernizing air defenses.

Russia's air defense system has many problem areas. (Press reports vary on Moscow's assessment of its present capability system to repel a large-scale aerospace attack, and although some reports are optimistic, most are not.)[70] However, one should not underestimate that system. Moscow still maintains the most comprehensive integrated air defense in the world, remaining a world leader in the development and production of air defense systems, including radars, missiles, guns, and control systems. Its individual systems, especially surface-to-air missiles (SAM), remain very formidable. Although the Russian strategic SAM force continues to be based primarily on updated Soviet legacy systems—mostly the SA-10 and -20—the military is steadily deploying new SAMs, especially the S-400/SA-21 Growler.[71] Two new systems, the S-350 Vityaz and the S-500, are in development.[72] The deployment of new or upgraded fighters and interceptors for Russia's air units has also gradually increased in recent years.[73] Although major procurement of the fifth-generation PAK-FA/T-50 has been delayed for several years, the RuAF continues to procure other modern aircraft, including an order for 50 more of the very formidable Su-35S, reported in early 2016.[74] We should expect that, over time, ongoing force modernization and realignments—such as Russia's reorganization of its air forces and the air

and space defense force into an entirely new structure in 2015, along with readiness improvements as demonstrated by its intervention in Syria—will correct many deficiencies and result in steadily more capable defenses.[75] Whether doing so will be enough to change Russians' view of the threat situation remains to be seen—after all, we are dealing with people who may well believe that NATO actually can attack the Moscow area with 1,500 combat aircraft and that the United States is expanding its network of military-biological laboratories in the countries around Russia.[76] In spite of these upgrades, if Moscow continues to perceive itself as unable to successfully combat a large-scale enemy aerospace attack, ultimately it will remain dependent on the threat of nuclear escalation to deter or repel such a strike.

Conclusions and Implications

The Russian threat model is clearly based on the Western air campaigns in Iraq and Yugoslavia—campaigns in which forward bases were available, air units could forward-deploy prior to the start of hostilities, and the air campaign was meticulously prepared in advance. This set of circumstances is unlikely to be repeated in any conflict with Russia. If anything, in any such conflict, the overwhelming likelihood will be that the United States and NATO will respond in desperate haste to a Russian initiative—that is, for us, it will be a come-as-you-are war.[77] Further, when we consider Russia's obvious overestimation of Western capabilities, reflected in its conception of an anti-Russia air campaign, it is clear that the massive aerial threat from the United States and NATO perceived by Russian writings is based far more on illusion than fact.[78] In actuality they face much less of an aerospace threat than they claim.

Certainly, the Russians have great, even exaggerated, respect for American and Western aerospace power, and they expect that power to increase as the United States and NATO deploy improved systems, such as the F-35; larger amounts of existing equipment, especially cruise missiles; and future weapons, such as ballistic missile defense and "prompt global strike systems." (In 2012 Prime Minister Putin went so far as to claim that the United States was seeking a monopoly on survivability.)[79] Further exacerbating the Russians' concern is fear of Western technological superiority and the possibility that Western technological surprise may render their defenses obsolete.[80] This apprehensiveness is the product of a worst-case analysis, but what matters is that the Russians believe their perceptions and that these perceptions are likely to mean stability in some circumstances coupled with the potential for great danger in others. In circumstances that make Russian-American relations stable and reasonably businesslike, threat perceptions are largely irrelevant. Unfortunately, we may not encounter such circumstances for the foreseeable future. When tension builds, the perceived threat of Western conventional aerospace superiority might serve as a deterrent. In a crisis, however, if the Russians believe they are facing a use-it-or-lose-it situation—especially with their nuclear weapons—it might prompt them to move first, especially if perceived Western aerospace conventional superiority is coupled to what the Russians believe is an effective US ballistic missile defense system.[81] Although the new Russian military doctrine

reportedly talks about nonnuclear deterrence, this fundamental situation is unlikely to change for many years.[82] However, the likelihood of such a crisis is actually low. For a start, the potential for ambiguous warfare against the members of NATO adjacent to Russia is much less than in Ukraine. Since they are members, that organization's security guarantees apply.[83] Second, NATO will forward-deploy deterrent trip-wire forces there, thus decreasing the risk of both deliberate and opportunistic Russian intervention. Third, NATO members have coherent governments capable of resisting subversion (an Estonian general remarked that the way to deal with "little green men" [Russian soldiers whom Russia denies are there] is to "shoot the first one to appear."[84] Finally, if such a crisis occurs, it will undoubtedly be at Putin's initiative. Consequently, he can accept as much or as little risk as he wants, and, as has happened in Ukraine, he can dial tensions down as well as up. Unfortunately, since we are dealing with a Russian leader who sees intent, malice, and organization where he should see confusion and incoherence and who perceives threats where none exist, this situation retains the potential for dangerous miscalculation. ✪

Notes

1. See Hugo Spaulding, "Putin's Next Objectives in the Ukraine Crisis," backgrounder (Washington, DC: Institute for the Study of War, 3 February 2015), http://www.understandingwar.org/sites/default /files/Ukraine%20backgrounder_V6.pdf.

2. Anton Barbashin and Hannah Thoburn, "Putin's Brain," *Foreign Affairs*, 31 March 2014, http:// www.foreignaffairs.com/articles/141080/anton-barbashin-and-hannah-thoburn/putins-brain?sp _mid=45536173&sp_rid=YXRtbWNjYWJlMUB2ZXJpem9uLm5ldAS2. In particular, the authors assess the influence of Alexander Dugin and his theories of Eurasianism on Putin's thinking.

3. The term *ambiguous warfare* is from Ronald O'Rourke, *A Shift in the International Security Environment: Potential Implications for Defense—Issues for Congress*, CRS Report R43838 (Washington, DC: Congressional Research Service, 8 June 2016), https://www.fas.org/sgp/crs/natsec/R43838.pdf. Putin is using a modification of what he considers the Western strategy of fomenting disorder by using subversion and special operations to produce regime change, as he believes the United States and its allies did in Libya and intended to do in Syria. For an excellent summary of Russian thinking on this subject, see Col S. G. Chekinov (Res) and Lt Gen S. A. Bogdanov, retired, "The Nature and Content of a New-Generation War," *Military Thought*, no. 4 (2013), http://www.eastviewpress.com/Files/MT _FROM%20THE%20CURRENT%20ISSUE_No.4_2013.pdf. The Russians assume that somewhere in the US government, there really is a big picture. Obviously, they are mirror-imaging.

4. See especially par. 39 (d) of "Concept of the Foreign Policy of the Russian Federation" (unofficial translation), Ministry of Foreign Affairs of the Russian Federation, 12 February 2013, http://www.mid .ru/brp_4.nsf/0/76389FEC168189ED44257B2E0039B16D. This policy is especially significant to Estonia (25.5 percent Russian-speaking) and Latvia (25.8 percent Russian-speaking). The Estonian population figure is from "Population by Nationality," Estonia.eu, http://estonia.eu/about-estonia/country/population -by-nationality.html. The Latvian figure is from "At the Beginning of 2015 Population of Latvia Decreased by 15.4 Thsd People," Baltic Course, 27 May 2015, http://www.baltic-course.com/eng/analytics/?doc= .

5. Putin's view of a US destabilization of Russia is noted in "A Ukraine-Russia Peace Deal: Crimea Must Have a Cost," *In Moscow's Shadows*, 1 January 2015, https://inmoscowsshadows.wordpress .com/2015/01/01/a-ukraine-russia-peace-deal-crimea-must-have-a-cost/. Supposedly, this piece was written by Josh Rogin in *Bloomberg*.

6. For a good summary, see Pavel Felgenhauer, "Despite Bilateral Diplomatic Contacts, Russia Hardens Its View of US as the Enemy," *Eurasia Daily Monitor* [Jamestown Foundation] 13, issue 63 (31 March 2016), http://www.jamestown.org/single/?tx_ttnews%5Btt_news%5D=45257&no_cache=1# .V2g7DBJ8PMM. See also Anthony H. Cordesman, "The Background to Putin's Actions in Syria and the

UN: Russia's New View of the US and Western Strategy; the Color Revolution" (Washington, DC: Center for Strategic and International Studies, 2 October 2015), https://www.csis.org/analysis/background-putin%E2%80%99s-actions-syria-and-un-russia%E2%80%99s-new-view-us-and-western-strategy-color; and Chekinov and Bogdanov, "Nature and Content."

7. James T. Quinlivan, "Yes, Russia's Military Is Getting More Aggressive," *Foreign Policy*, 30 December 2014, http://foreignpolicy.com/2014/12/30/yes-russias-military-is-getting-more-aggressive/?utm_source =Sailthru&utm_medium=email&utm_term=Flashpoints&utm_campaign=2014_FlashPoints%20 %5BManual%5DRS12%2F30. For information on the planned Russian buildup, see John Hall, "Russia Announces Plans to Deploy Military Divisions on Western Border and Form New Nuclear Regiments," *Independent* [UK], 12 January 2016, http://www.independent.co.uk/news/world/europe /russia-announces-plans-to-deploy-military-divisions-on-western-border-and-form-new-nuclear-regiments -a6807906.html. See also John R. Schindler, "Kremlin Provocations and War Games Risk Real War," *Observer* [UK], 2 May 2016, http://observer.com/2016/05/kremlin-provocations-and-war-games-risk -real-war/.

8. *Warsaw Summit Communiqué*, par. 40, North Atlantic Treaty Organization, 9 July 2016, http:// www.nato.int/cps/en/natohq/official_texts_133169.htm.

9. The previously noted Russian theorist Alexander Dugin, whose thinking reportedly has major influence on Putin's, says that a nationalist Russia supporting a multipolar world is currently in an inevitable conflict of civilizations with the universalist West and a hegemonic United States, along with a heartland/rimland geopolitical conflict. See Alexander Dugin, "Alexander Dugin on Eurasianism, the Geopolitics of Land and Sea, and a Russian Theory of Multipolarity," *Theory Talks*, no. 66 (7 December 2014), http://www.theory-talks.org/2014/12/theory-talk-66.html.

10. Gen-Col Aleksandr Zelin, "The Air Force, Its Role and Place in Armed Conflicts," *Moscow IA Integrum-Tekhno*, 6 August 2008. Zelin was then commander in chief of the Russian Air Forces. See also Yu. V. Krinitsky, "Aerospace: The Main Theater of Operations," *Military Thought in English*, no. 3 (2013): 150–61. The information sphere may also be considered a center of warfare. General of the Army Nikolay Makarov, Chief of the Russian General Staff, "Reform Is Producing Necessary Results," *Moscow Nezavisimoye Voyennoye Obozreniye*, 17 February 2012.

11. General of the Army A. M. Kornukov, "Apropos of the Grown Role of Confrontation in the Aero-space Sphere and Air Force Tasks in 21st-Century Military Operations," *Military Thought*, 1 September 2001, http://www.highbeam.com/doc/1G1-80321751.html.

12. Ibid.; and Gen-Maj S. V. Kuralenko, "Changing Trends in Armed Struggle in the Early 21st Century," *Military Thought in English*, no. 4 (December 2012): 29.

13. "Yesterday Yugoslavia, but Who Tomorrow? An Analysis of U.S. and NATO Operational Training Measures in the European Theater of Military Operations in 1998–2002," *Vozdushno-Kosmicheskaya Oborona*, 5 June 2008.

14. Kornukov, "Apropos."

15. Ibid.

16. Kuralenko, "Changing Trends," 31.

17. Kornukov, "Apropos."

18. Oleg Falichev, "Secret Springs of the War in Iraq," *Krasnaya Zvezda*, 28 June 2003; and Gen-Col Boris Cheltsov, "Approaches to the Creation of the National Aerospace Defense System in the Conditions of Future Network-Centric Wars," *Military Thought*, no. 4 (2008): 1–11, http://www.highbeam.com /doc/1G1-194154586.html.

19. Kornukov, "Apropos."

20. Ibid.

21. Falichev, "Secret Springs"; and Kuralenko, "Changing Trends," 31.

22. I. N. Vorobyov, "Characteristics of Combat Actions (Operations) in Future Wars," *Military Thought*, 1 April 2005, http://www.highbeam.com/doc/1G1-135818481.html; and Kuralenko, "Changing Trends," 32. See Chekinov and Bogdanov, "Nature and Content."

23. Gen-Maj Andrey Demin, "Voyennyy Sovet (Military Council) Interview," *Moscow Ekho Moskvy*, 30 June 2012.

24. "7,000 U.S. Cruise Missiles Pose 'Dominant Threat to the Modern World,'" *Moscow Times*, 8 December 2014, http://www.themoscowtimes.com/news/article/7-000-u-s-cruise-missiles-pose-dominant -threat-to-the-modern-world/512752.html; and Kuralenko, "Changing Trends," 30.

25. Dmitriy Rogozin, "Five War Scenarios: Dmitriy Rogozin: Russia Must Be Independent and Strong, or It Will Not Exist at All," *Moscow Rossiyskaya Gazeta*, 3 July 2013. Other Russian analysis is skeptical of this claim, as noted in Vladimir Dvorkin, "Risky Contradictions: Putin's Stance on Strategic Arms and Missile Defense," Carnegie Moscow Center, 10 February 2016, http://carnegie.ru/commentary/2016/02/10/risky-contradictions-putin-s-stance-on-strategic-arms-and-missile-defense/itq8?mkt_tok=3RkMMJWWfF9wsRovv6zBZKXonjHpfsX56OwvXKKg38431UFwdcjKPmjr1YoDTcZ0aPyQAgobGp5I5FEIQ7XYTLB2t60MWA%3D%3D.

26. Kornukov, "Apropos."

27. "Yesterday Yugoslavia."

28. Kuralenko, "Changing Trends," 32. This might be done to justify US or NATO intervention under the cover of humanitarian intervention. See also Chekinov and Bogdanov, "Nature and Content."

29. General of the Army Valery Gerasimov, "The Value of Science Is in the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying Out Combat Operations," *Voyenno-Promyshlennyy Kuryer*, 26 February 2013. That a population might revolt, demanding better government, is utterly alien to the Putin government's concept of the universe. Therefore, the color revolutions in Ukraine and Georgia, the Maiden Revolution in Ukraine, the Arab Spring, and the demonstrations against Putin's election were due to Western subversion. See also General of the Army Makmhut Gareyev, "Text of Speech to the Academy of Military Science General Meeting," *Voyenno-Promyshlennyy Kuryer*, 25 January 2012. Gareyev is president of the Russian Academy of Military Sciences.

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32. Kuralenko, "Changing Trends," 29.

33. G. P. Kupriyanov, "Principal Trends in the Evolution of Space Warfare," *Military Thought*, 1 January 2005, http://www.highbeam.com/doc/1G1-136342873.html.

34. I. N. Vorobyov and V. A. Kiselyov, "The Promise of Defense," *Military Thought*, 1 January 2007, http://www.highbeam.com/doc/1G1-166433360.html; and Kuralenko, "Changing Trends," 32.

35. Kornukov, "Apropos."

36. Kuralenko, "Changing Trends," 32.

37. Rogozin, "Five War Scenarios." Quotation from V. V. Barvinnko, "Aerospace Defense: Modern Aspects," *Military Thought*, 1 January 2007, http://www.highbeam.com/doc/1G1-166433377.html.

38. Kuralenko, "Changing Trends," 31.

39. Kornukov, "Apropos."

40. Oil and energy production may be a primary target. Some Russian analysts claim that American analysts assert that destroying as few as 12 such targets could paralyze Russia. Vyascheslav Tetekin and Aleksandr Brusnitsyn, "Source of the Main Threat: Today There Is Practically Nothing with Which to Repel the Probable Enemy's Strikes from the Aerospace Northern Strategic Axis," *Voyenno-Promyshlennyy Kuryer*, 26 June 2013.

41. Kupriyanov, "Principal Trends."

42. Kuralenko, "Changing Trends," 31; and Kupriyanov, "Principal Trends."

43. The author has not been able to identify the exercises on which these scenarios are supposedly based. The alleged exercises they refer to may never have happened.

44. "Yesterday Yugoslavia."

45. Ibid.

46. Ibid.

47. Ibid.

48. The scenario varied according to the strategic axis. One or two air offensives occurred on the northwest axis—on the southwest axis, no more than one. The article was unclear about whether each of these was a different air campaign or whether they were all included in one air campaign. See ibid.

49. Ibid.

50. Ibid.

51. Ibid.

52. Ibid.

53. Ibid.

54. Ibid.

55. As warned by General of the Army Yuriy Baluyevskiy, chief of the Russian General Staff, in 2008. See Aleksandr Aleksandrov, "National Security of Russia at the Contemporary Stage," *Krasnaya Zvezda*, 23 January 2008.

56. "Report on Scientific Conference Organized by Academy of Military Sciences, MoD," *Krasnaya Zvezda*, 23 January 2008; and Kornukov, "Apropos."

57. Kornukov, "Apropos."

58. Ibid.

59. Aleksandrov, "National Security of Russia."

60. The defenders may have only "minutes" to respond. Demin, "Voyennyy Sovet (Military Council) Interview."

61. Gen-Col Boris Cheltsov, "Cheltsov on Need to Alter Russian Military Doctrine," *Voyenno-Promyshlennyy Kuryer*, 25 April 2007.

62. Kornukov, "Apropos"; and President Vladimir Putin, "Priority Tasks of the Development of the Russian Federation Armed Forces, Defense Military of the Russian Federation," 3 October 2003, http://red-stars.org/doctrine.pdf.

63. Vorobyov and Kiselyov, "Promise of Defense."

64. Kornukov, "Apropos."

65. Ibid.

66. President Dmitry Medvedev, "Text of Newly-Approved Russian Military Doctrine," Carnegie Endowment for International Peace, 5 February 2010, http://www.carnegieendowment.org/2010/02/05/text-of-newly-approved-russian-military-doctrine/l8t. Evidently the Russians have continued this right in the most recent edition of their military doctrine. See Vladimir Dvorkin, "Nuclear Weapons in Russia's Amended Military Doctrine," Carnegie Moscow Center, 22 January 2015, http://carnegie.ru/eurasiaoutlook/?fa=58774.

67. The threat of retaliatory escalation evidently does not enter the Russian picture. See Nikolai Sokov, "Why Russia Calls a Limited Nuclear Strike 'De-escalation,' " *Bulletin of the Atomic Scientists*, 13 March 2014, http://thebulletin.org/why-russia-calls-limited-nuclear-strike-de-escalation.

68. Throughout the Cold War, Soviet national air defense was a separate military service. See Harriet Fast Scott and William F. Scott, *The Armed Forces of the USSR* (Boulder, CO: Westview Press, 1979), 147–53.

69. Especially older systems, such as the SA-2/3/5 and the MiG-23 and Su-15 interceptors.

70. "Russia's Air Defense Capabilities Rule Out War According to 'Iraqi-Libyan Scenario,' " *Moscow Interfax*, 21 April 2011. For recent pessimistic reports, see Aleksandr Tarnayev, "Who Will Defend Our Sky? Only a New Aerospace Defense System Will Be Capable of Disrupting an Enemy Land-Air-Space Attack," *Voyenno-Promyshlennyy Kuryer*, 21 August 2013; and Oleg Falichev, "Aerospace Defense: Growing Pains Two Years after the Russian President's Edict on the Formation of the Aerospace Defense Troops, the System is in a State of Uncertainty," *Voyenno-Promyshlennyy Kuryer*, 9 October 2013.

71. "S-400 Triumph Missile Systems Put on Combat Duty in Siberia," *Tass*, 1 March 2016, http://tass.ru/en/defense/859835.

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73. In 2014 the RuAF reported receiving 53 new Su-30 and Su-35 fighters, 16 new Su-34 fighter-bombers, 18 upgraded MiG-31BM interceptors, and 7 upgraded Tu-160 and Tu-95 strategic bombers. See Alexander Tikhonov, "Year of Achievement," *Red Star*, 19 December 2014, http://redstar.ru/index.php/component/k2/item//20730-shapka. I have not been able to find detailed figures for 2015 procurement. Aggregate projections released by the Russian Air Forces were for "nearly 150 new and modernized planes and helicopters" by the end of 2015, so deliveries were likely at least comparable. See "Nearly 150 New Aircraft to Join Russian Air Force in 2015," *Sputnik*, 14 August 2015, http://sputniknews.com/military/20150814/1025749884/russian-air-forces-150-new-aircraft.html.

74. Dmitry Gorenburg, "Russian Stealth Fighter Will Enhance Air Force Capabilities," *Russian Military Reform: Tracking Developments in the Russian Military* (blog), 5 November 2015, https://russiamil.wordpress.com/. The latest upgrade of the Su-27 Flanker design. Nikolai Novichkov, "Russia Orders 50 Su-35S Multirole Fighters," *IHS Jane's Defence Weekly*, 14 January 2016, http://www.janes.com/article/57187/russia-orders-50-su-35s-multirole-fighters.

75. Matthew Bodner, "Russia Merges AF with Missile Defense, Space Commands," *Defense News*, 8 August 2015, http://www.defensenews.com/story/defense/air-space/air-force/2015/08/08/russia-merges-af-missile-defense-space-commands/31221349/.

76. Vladimir Putin, *Edict of the Russian Federation President: On the Russian Federation's National Security Strategy*, December 2015, [5], http://www.ieee.es/Galerias/fichero/OtrasPublicaciones/Internacional/2016/Russian-National-Security-Strategy-31Dec2015.pdf.

77. For the difficulties of fighting such a war, see Lt Col Thomas McCabe, USAFR, Retired, "Airpower in the Next War: In the Shadow of Georgia," *Air and Space Power Journal* 23, no. 4 (January 2009): 58–67, http://www.au.af.mil/au/afri/aspj/airchronicles/apj/apj09/win09/win09.pdf.

78. Frankly, as a former Air Force officer, I would be ecstatic if the reality were anywhere close to their perceptions.

79. Prime Minister Vladimir Putin, "Prime Minister Vladimir Putin Meets with Experts in Sarov to Discuss Global Threats to National Security, Strengthening Russia's Defenses and Enhancing the Combat Readiness of Its Armed Forces," transcript, Archive of the Official Site of the 2008–2012 Prime Minister of the Russian Federation Vladimir Putin, 24 February 2012, http://archive.premier.gov.ru/eng/events/news/18248/.

80. In 2013 the Russians estimated that in critical basic technologies they were "dozens of years" behind the advanced nations. See Rogozin, "Five War Scenarios." The Russians expound at length on a wide variety of possible future weapons, including prompt global strike / conventional ballistic missiles, hypersonic weapons, space-based attack weapons, reusable aerospace aircraft, remotely piloted reconnaissance strike aircraft, and weapons based on new scientific principles, such as energy weapons. See Gen-Col A. I. Khyupenen and Col A. I. Krinitsky, "Deployment of Aerospace Defenses for Russia's Military Security," *Military Thought*, no. 3 (2012): 63. As a rule, these systems are either in or barely out of the PowerPoint stage.

81. Historically, the Russians, and before them the Soviets, have had greatly exaggerated respect for the potential of America's missile defense. What do they know that we don't?

82. Roger McDermott, "Putin Signs New Military Doctrine: Core Elements Unchanged," *Eurasia Daily Monitor* [Jamestown Foundation] 12, no. 2 (6 January 2015), http://www.jamestown.org/programs/edm/single/?tx_ttnews%5Btt_news%5D=43236&tx_ttnews%5BbackPid%5D=27&cHash=25357b7ab5d6d79e6372f1275db4120f#.VO9tpU18Nkc.

83. Lukas Milevski, "Little Green Men in the Baltic States Are an Article 5 Event," *FPRI* [Foreign Policy Research Institute] *Baltic Bulletin*, January 2016, http://www.fpri.org/article/2016/01/little-green-men-in-the-baltic-states-are-an-article-5-event/.

84. Dan Altman, "The Long History of 'Green Men' Tactics—and How They Were Defeated," *War on the Rocks*, 17 March 2016, http://warontherocks.com/2016/03/the-long-history-of-green-men-tactics-and-how-they-were-defeated/.

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A Commonsense Approach to Intelligence, Surveillance, and Reconnaissance Operations

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In the summer of 2015, Department of Defense officials announced that combat air patrols (CAP) conducted by remotely piloted aircraft (RPA) would increase steadily, from 65 per day in October to 90 per day by the end of 2019.[1] Undoubtedly, this four-year-long expansion of the department's intelligence, surveillance, and reconnaissance (ISR) capabilities reflects the ever-increasing demand for tactical reconnaissance using MQ-1 Predators and MQ-9 Reapers to monitor current and anticipated crises abroad. According to February 2016 figures, the US Air Force and its distributed common ground system (DCGS) fly 61 CAPs per day.[2] Looking forward four years' time, without significant increase in either US or allied involvement, one can assume that the Islamic State's territory and influence will continue to expand and that new conflict zones—perhaps in the South China Sea or the Baltic States—will emerge. If so, then the Air Force should expect that the demand for ISR and full-motion-video-based products from its intelligence operators will probably exceed the means to provide them.

Granted, the Department of Defense is taking a combined approach. The US Army and contractors will assume responsibility for some of the CAPs in the coming years, but the lion's share of the work belongs to the Air Force. Meanwhile, Air Combat Command's senior general is getting a palpable sense of the fatigue experienced by RPA mission crews. "We've been in surges continuously for the last eight years," said Gen Herbert "Hawk" Carlisle during a September 2015 talk at the Center for Strategic and International Studies in Washington. "We went from 21 CAPs in 2008 to 65 CAPs."[3] He further remarked that the Air Force is the smallest it has been since the service's founding in 1947, with the fewest personnel and the least number of aircraft, including RPAs.[4] Critical manpower shortages in the intelligence officer career field might also be connected to the stress of working at surge capacity.[5]

Yet, the Defense Department and the intelligence community's demand for ISR shows no signs of abatement. How can we balance their demands and improve the DCGS over the next four years? This analysis seeks to explore the answers to this important question—specifically, by addressing combat automation and a new focus on intelligence projects rather than intelligence products.

Working Smarter with Combat Automation

Stress upon DCGS Airmen—those assigned to the Predator and Reaper career fields in particular—has been increasingly documented since early last year. A March 2015 study published in *Military Medicine* reported that 20 percent of DCGS operators self-reported varying degrees of fatigue or psychological stress.[6] Six months later, Col Troy Jackson, head of the Air Force's Culture and Process Improvement Program, pointed out in a subsequent interview that "Airmen in this career field are being exhausted with no end in sight; we want to fix this."[7] An Air Combat Command study on the subject commissioned by the program seems to acknowledge this fact, and ultimately the Air Force will undertake 140 recommendations to improve RPA operations.[8] DCGS mission crews have preemptively started to reduce their daily, nightly, and midshifts from 12-plus hours to 8.

Further, the service should undertake other, more palliative, measures to reduce mission fatigue. Most, if not all, of these solutions involve what Capt Michael Byrnes calls "combat automation," a term he coins in "Dark Horizon," his trenchant contribution to the *Air and Space Power Journal*'s "Nightfall" series of articles. Combat automation is "the transfer of a task normally performed by an operator of a military aircraft to the control of an automated system, typically a digital computer."[9] Some commonly used examples of combat automation, according to Byrnes, include devices like autopilots or modern navigation systems. For the purposes of this article, we can adapt Byrnes's definition and supplant "aircraft" with "DCGS weapons system."

Some measure of combat automation in the DCGS weapons system can be achieved by using commonly available tools. Off-the-shelf technologies, such as speech-to-text software, could reduce the time that mission operations commanders or tactical communicators spend with computer keyboards manually placing messages into Internet relay chat windows. Other means to reduce fatigue—such as software applications that could quickly aggregate large amounts of data—are not quite off-the-shelf: they might require more bespoke solutions instead. Advanced computer algorithms or programming code can be employed to inspect full motion video products for aberrations, abnormalities, or mistakes, greatly reducing the time spent by mission operations commanders or imagery mission supervisors quality-checking analysts' work before it reaches the customer. RAND's Project Air Force proposed similar measures in 2012. Automatic target-recognition technologies can help imagery analysts and screeners maintain "nonhuman eyes" on full motion video and cue them to view predetermined areas of interest.[10]

The advent of cloud computing over the last half decade also presents exciting prospects for cross-domain solutions. A Citrix-based computer architecture can facilitate mission crew members' shifts between classified and unclassified computer

networks. Such architecture might also reduce the time necessary to access—or even the desire for—shared computer drives or folders. Most importantly, however, it could also bridge the gaps between data storage systems such as the Unified Collection Operations Reporting Network, ISR Assessment Tool, and Skynet. All of these disparate systems, administered by diffuse entities, track similar, mission-related information. Finally, advanced algorithms can automatically create postmission summaries—or any report, for that matter—with free-text syntax so precise that the computer-generated report is virtually indistinguishable from the human-generated one.[11]

Toward a New Model

The DCGS weapons system's mission is CPAD: the collection, processing, exploitation, analysis, and dissemination of intelligence.[12] However, this article proposes that CPAD is in fact a method or a means of attaining heightened awareness of one's own battlespace. It should not be an end unto itself. An unpublished white paper on the subject of CPAD as a methodology for intelligence work posits that the weapons system would be better suited to answering fundamental intelligence questions contained in documents such as commanders' priority intelligence requirements if it departed from a product-centric approach and adopted a project-based one.[13]

On the one hand, a product-centric approach concentrates on producing intelligence products almost for the sake of production. The weapons system, in this regard, is like an assembly line whose governing tenets are quantity, frequency, and a machine-like predictability. This construct also has a very high regard for statistics that specifically measure quantity, as opposed to the quality of the intelligence produced or its impact on battlefield decision making. On the other hand, a project-based approach not only would treat priority intelligence requirements as going concerns but also would be in conformance with the all-source methodologies adopted by most of the intelligence community's agencies. At these agencies, intelligence projects begin with strategic questions such as, "Will the enemy employ WMD [weapons of mass destruction]?"[14] Teams in the Air Force's ISR weapons system should be built and resourced similarly. The teams' size or scope can be scalable to answer more tactical questions such as, "How will the adversary employ WMDs?" or "What means will it use to cover or conceal its activities?" Routinely answering questions like these can help analysts become more conversant with regional ballistic missiles defense or the threat of using WMDs posed by transnational groups like the Islamic State. As a result, teams will unite with a common purpose, helping build competition and morale. Employing this method might also reduce the malaise that comes from the product-centric approach. Most importantly, it might mean greater involvement from the weapons system's DCGS analysis and reporting teams, which could use the predictive techniques proposed here and help decision makers on the ground see crises as they emerge, instead of reporting them in retrospect.

In the meantime, more stressors on the weapons system and its operators will arise. Between now and 2019, the Air Force should work toward a new CAP crew-manning scheme—one in which automation meets common sense. We may not be
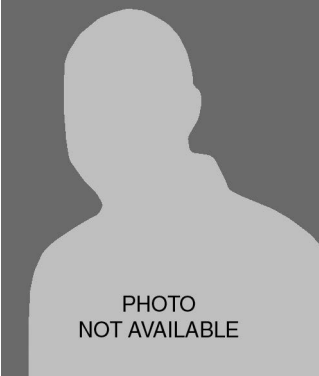
able to reduce either the demand for ISR or fatigue on our Airmen. Nevertheless, we may yet have it in our power to increase their morale and revitalize the weapons system by using the measures proposed here and renewing their commitment to a common purpose—to answer our field commanders' critical intelligence questions more efficiently and effectively. ✪

Notes

1. Gordon Lubold, "Pentagon to Sharply Expand U.S. Drone Flights over Next Four Years," *Wall Street Journal*, 16 August 2015, http://www.wsj.com/articles/pentagon-to-add-drone-flights-1439768451.

2. Brian W. Everstine, "Don't Fear the Reaper," *Air Force Magazine* 99, no. 2 (February 2016): 18–23, http://www.airforcemag.com/MagazineArchive/Documents/2016/February%202016/0216reaper.pdf.

3. Mark Pomerleau, "Carlisle: Overworked Airmen Can't Train for Future Threats," Defense Systems, 18 September 2015, https://defensesystems.com/Articles/2015/09/18/Hawk-Carlisle-Air-Force-training-shortfall.aspx.

4. Ibid. The Air Force's inventory includes more than 140 Predators and nearly 250 Reapers. See Tom Kaminski, "USAF TACAIR: Combat Edge," *Air Forces Monthly*, no. 335 (February 2016): 44–59.

5. Department of the Air Force, memorandum, subject: Air Reserve Component (ARC) 14N Intelligence Officer Voluntary Limited Period of Active Duty (VLPAD) Program Implementation and Eligibility Criteria, 17 November 2015.

6. Lillian Prince et al., "Reassessment of Psychological Distress and Post-Traumatic Stress Disorder in United States Air Force Distributed Common Ground System Operators," *Military Medicine*, no. 180 (March 2015): 172. The authors study stressors that contribute to fatigue in the DCGS, including "long hours, rotating shift work, sustaining vigilance, and processing continuous auditory and visual data during aerial missions." The sample size of the researchers' survey encompassed 1,091 DCGS intelligence operators and 447 nonintelligence support personnel. They estimated that their results represented 31 percent of Air Force intelligence organizations (p. 173).

7. Shaun Eagan, "New ACC Program Begins, Aimed to Improve MQ-1/9 Community," US Air Force, 1 September 2015, http://www.af.mil/News/ArticleDisplay/tabid/223/Article/615577/new-acc-program-begins-aimed-to-improve-mq-19-community.aspx.

8. Everstine, "Don't Fear the Reaper," 3.

9. Capt Michael W. Byrnes, "Dark Horizon: Airpower Revolution on a Razor's Edge—Part Two of the 'Nightfall' Series," *Air and Space Power Journal* 29, no. 5 (September–October 2015): 33, http://www.airpower.maxwell.af.mil/digital/pdf/issues/2015/ASPJ-Sep-Oct-2015.pdf.

10. Lance Menthe et al., *The Future of Air Force Motion Imagery Exploitation: Lessons from the Commercial World* (Santa Monica, CA: RAND Corporation, 2012), 8–9, http://www.rand.org/content/dam/rand/pubs/technical_reports/2012/RAND_TR1133.pdf.

11. A June 2015 article in *Harper's Magazine* lists papers published by the Institute of Electrical and Electronics Engineers but retracted after someone discovered that they had been written by free-text-simulating algorithms. The list includes titles such as "A Methodology for the Exploration of Web Browsers" and "The Effect of Pervasive Algorithms on Artificial Intelligence." See "Bot for Teacher" *Harper's Magazine*, June 2015, 14. Interestingly, Captain Byrnes's work posits that senior leaders might have an aversion to automation generally. In the pilot's case, software might simplify decision making too much, and the physical act of flying one's craft "would cease to be so." A similar argument for intelligence work might hold true—that with so much computer programming, human cognition would be oversimplified and would cease to be true analysis. Byrnes, "Dark Horizon," 44.

12. "Air Force Distributed Common Ground System," US Air Force, 31 October 2015, http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104525/air-force-distributed-common-ground-system.aspx.

13. Lt Col David Vernal, "ISR Efforts: A Project-Based Approach to ISR Capability, Force Presentation, and ISR Assessment," unpublished white paper, 2015.

14. Carl Rhodes, Jeff Hagen, and Mark Westergren, *A Strategies-to-Tasks Framework for Planning and Executing Intelligence, Surveillance, and Reconnaissance (ISR) Operations* (Santa Monica, CA: RAND Cor-

poration, 2007), 9, http://www.rand.org/content/dam/rand/pubs/technical_reports/2007/RAND
_TR434.pdf. The authors of this study, who pose a similar question in their work, propose introducing a
more deliberate planning method to resolve the disparity between the scarcity of intelligence re-
sources and customers' demands for them.

Maj William Giannetti, Virginia Air National Guard

Major Giannetti (MS, St. Joseph's University) is an intelligence officer with the Virginia
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analyst. Major Giannetti served two tours in Afghanistan.

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http://www.airpower.au.af.mil

Gunning for the Red Baron by Leon Bennett. Texas A&M University Press (http://www .tamupress.com), John H. Lindsey Building, Lewis Street, 4354 TAMU, College Station, Texas 77843-4354, 2006, 216 pages, $29.95 (hardcover), ISBN 978-1-58544-507-3.

Gunning for the Red Baron by Leon Bennett mainly explores the technical aspects of gunnery and aerial combat among fighter pilots in World War I. Despite the book's focus on technical concepts, Bennett writes in such a straightforward manner that a reader of any technical aptitude can comprehend the information presented. Moreover, it is clear that the work is the result of the author's well-planned and thorough research. However, *Gunning for the Red Baron* fails to present a clear thesis; Bennett discusses two separate purposes at the beginning, but by the end, neither has been fully explored. The author may not fulfill his promises to the reader, but he does deliver a first-rate look into the technical challenges faced by British fighter pilots in World War I.

Leon Bennett certainly has the credentials to write about World War I aviation. Besides being a published aeronautical engineer, he has authored another book about Manfred von Richthofen, the Red Baron. Furthermore, the research behind the book is clearly more than adequate. Although it includes only about 180 pages of text, more than 120 references are listed in the bibliography, including primary sources of British and German origin along with a handful of French ones. Readers, therefore, need not worry about the accuracy of the information.

Bennett's previous experience in writing reveals itself in his style. He masterfully intertwines visual aids, which include photographs, diagrams, and charts, with transparent writing to easily explain technical concepts and present unique conclusions. The sheer number of historical photographs complements rather than overwhelms the writing because only relevant pictures are paired with the text on any particular page. The charts and diagrams, both historical and the author's, are also placed strategically to embellish the narrative and facilitate easy comprehension. The result is a book that is surprisingly quick to read.

With respect to organization, *Gunning for the Red Baron* is simply a mess. The book starts off well enough by providing key background about why air services were considered necessary. However, what follows is a muddled explanation of the study's organization and purpose. Bennett appears to toy with two different objectives: (1) analyzing all of the technical aspects of aerial combat in World War I as experienced by pilots of all major participating nations and (2) analyzing everything about the Red Baron, the pilots who fought him, and the technology involved in his air battles.

The author reveals the first purpose in the introduction: "This book is concerned with the craft of shooting down airplanes in the Great War. At issue are men, weapons, airplanes, and tactics. Examined are the lessons learned as every Air Service fought for dominance" (p. 5). This sentence, in conjunction with a graph of air service casualties of France, Germany, the United Kingdom, and the United States, which also appears in the introduction (p. 3), implies that the scope of the book covers these four nations. Even the description on the book jacket implies it will be all-encompassing, but this promise is never fulfilled. Markedly British-centric, *Gunning for the Red Baron* fully explores only the technical aspects of the British air service. Seven of the nine chapters relate to technology, but just three refer to the German air service, of which only one does so thoroughly. The other four concern themselves with only the British perspective. Ironically, Bennett admits to the British slant in the "Acknowledgements": "Without these magnificent British sources, the book would lack content." The title of the book, though, and information in the book jacket suggest that the real objective is to examine von Richthofen in detail. (Only chapter 8, however, which explores two of his dogfights, fulfills this purpose.) The author attempts to reference the Red Baron in earlier parts of the book but does so inappropriately. A prime example occurs in chapter 6,

in which Bennett clumsily throws in a quip about von Richthofen's career in the middle of a discussion about World War I fighter design (p. 108). One chapter is not nearly enough to fully explore the Red Baron's World War I experiences.

The author commits one final organizational blunder by including chapter 9, which relates to neither of his two purposes. Granted, it offers interesting information and insight into why both German and British aces have limited numbers of victories, but it is irrelevant to the rest of the study. Bennett should have conducted further research on the topic and expanded chapter 9 for publication either as a monograph or as a stand-alone book.

Besides failing to meet its objectives, *Gunning for the Red Baron* provides an original and thrilling look into the detailed technical aspects of aerial combat in World War I from the British perspective. It is a must-have for anyone who wishes to learn about this topic and is a good starting point for academics researching anything related to aerial combat during the Great War. There is one caveat, however. To enjoy the book and to avoid disappointment or confusion, readers should (1) ignore both the title and certain information in the book sleeve and introduction, (2) ignore chapters 8 and 9, and (3) approach the book with the expectation that it is a strictly informative piece about the technical aspects of air combat in World War I from the British viewpoint. *Gunning for the Red Baron* is far from perfect, but the author's diligent research and plain writing style more than make up for its shortcomings.

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Wings of War: Great Combat Tales of Allied and Axis Pilots during World War II by James P. Busha. Zenith Press (http://www.zenithpress.com), 400 First Avenue North, Suite 400, Minneapolis, Minnesota 55401, 2015, 256 pages, $30.00 (hardcover), ISBN 978-0-7603-4852-9.

Wings of War is a historical study brilliantly organized by the true experiences of many former Allied and Axis pilots during 1939–45 in World War II. Author James Busha chronologically explores the diverse events that occurred through the eyes of the pilots who were in the theater. He argues that despite their specialized training and the state-of-the-art aircraft manufactured for war fighting, the flyers on both sides were often forced to learn on the job, improvise during crucial moments, and master the demands of their profession. His snapshots are all excerpts from his many personal interviews albeit conducted many decades removed from the battle theater. This method not only gives the novel an authentic touch but also sheds light on perspectives from the war rarely mentioned in history books. Recommended for readers of World War II books and flying lovers of all generations, Busha's *Wings of War* is a collection of powerful narratives that gives greater agency to the earliest air fighters in history.

Historians often point to complex, global political shifts as one of the reasons that the period between the start and end of the war was so intriguing. Although the author occasionally alludes to certain political moments, the bulk of his writing focuses on the individual(s) at a specific place at a certain time. This technique is one of the book's greatest strengths, allowing him to illuminate and give equal attention to pilots on both sides.

Political historiography often hides the fact that the training and equipment of Axis flyers during the early years of the war, especially those from the Luftwaffe, were on par with those of their Allied counterparts. For the most part, Busha relates the experiences of American, German, and British pilots. However, he also includes pilots from other politically contested places such as occupied Poland, occupied Hungary, colonial New Zealand, and Canada, where an American decided to fight for the Royal Canadian Air Force. These diverse snapshots

of the war from inside the cockpit further reinforce his claim that despite the linguistic, cultural, and technological differences, pilots during the war were essentially similar. The high level of danger and uncertainty in any mission was present for both the few British pilots defending their homeland and the innumerable Luftwaffe aviators storming Britain. The book also highlights a particular relationship: the one between these men and their aircraft. The author's interviews give the reader a different perspective of the early aircraft used in the war. From the annoying nuances to the advantages of each flying machine, the pilots take us through their own process of discovering the capabilities and limitations of the airplanes. Sometimes they figured it out during training or practice flights; at other times, they did so during a live mission or a fight with enemy units. One man had "no two-seat trainers and no pilot notes to study—just a seasoned Hurricane pilot standing on the wing, leaning into [his] cockpit and telling [him] to push this button, pull this lever" (p. 27). Busha tries to show that the tactics and strategies of today's air warfare stem from the experiences and mistakes these pilots noted during their own phases of trial and error.

Although *Wings of War* draws on sources from various backgrounds, it does not fully encompass the global air fight between the Allied and Axis powers. Readers hoping for equal representation between the pilots on both sides will be disappointed to discover that this account is a compilation of tales from Allied flyers. Busha includes a few interviews with personnel who flew for Nazi Germany or its allies but none from the many Japanese who also flew in the Pacific theater. Moreover, only rarely does the book refer to the many Russians who flew in Eastern Europe. The experiences of and lessons learned from pilots in those other countries are crucial to a full understanding the global aspect of air warfare. They allow the reader to grasp why battles began and what the varying odds were. Granted, a huge linguistic and age barrier prevents Busha from locating all of these sources; however, he does not seem to have made much of an effort to find the stories of non-English-speaking veterans. The author does admit that, had he started this project years earlier, he would have had more people to talk to and more time to overcome the language barrier. Furthermore, Busha includes very little analysis of or commentary on the interviews he did conduct, each of which is supplemented by a follow-up session.

Regardless of these few flaws, *Wings of War* is recommended for all lovers of air warfare and aircraft. Not just anyone could have interviewed countless pilots and produced a book like this one—only a person capable of persuading the veterans to open up about their wartime experiences. The study's vast insight into pilots on both sides of the war is a valuable piece of aviation history that cannot be ignored. Considering the age of the flyers, it was very important that he complete these interviews. Although *Wings of War* is not the best book to use for studying the complexity of the geopolitical sphere, it is a worthy supplement that will prove useful to anyone interested in the early air fighters who gave rise to modern airpower.

<div align="right">

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The Evolution of Cyber Warfare: International Norms for Emerging Technology Weapons by Brian M. Mazanec. Potomac Books (https://www.nebraskapress.unl.edu /pages/PotomacBooks.aspx), 1111 Lincoln Mall, Lincoln, Nebraska 68588-0630, 2015, 352 pages, $34.50 (hardcover), ISBN 978-1-61234-763-9.

The title of Brian Mazanec's book is somewhat misleading, for this work does not explore the evolution of cyber war. Neither does it attempt to predict how cyber war will evolve. Instead, the study seeks to apply norms theory—a theoretical approach useful to both hard

and soft sciences—to war, a not-at-all scientific historical phenomenon whose most common norm seems to be expediency. In war, regardless of treaties and conventions (and, yes, norms), the prevailing rule is that might makes right, and the victors write volume after volume of history proving such to be the case.

In an ideal academic setting, Mazanec might use lessons learned from the application of norms-development theory to earlier instances of norms development for various emerging weapons technologies to anticipate what cyber war norms might evolve into. However, he is a federal employee with senior-level experience as a defense analyst and prior publications in the area of cyber warfare. Despite his bona fides, given the difficulty of applying any academic theory to real-world actions that put actual lives at risk, Mazanec has taken on a challenge that may well be insurmountable. With that caution, let us move on to the content of this study of how we come to have norms regulating warfare of various types.

First, because they are the basis for this book, we need to understand exactly what norms are. As the author reminds us, they are the agreed-to means of dealing with whatever issue society seeks to civilize. They are standards of appropriate or inappropriate behavior, not defined by nature but by society. According to norm theory, norms do not arise spontaneously and arbitrarily but evolve through a sequence of stages, each characterized by a set of elements.

In the first stage, norm emergence, old norms become obsolete or inappropriate to new conditions. In the void of normative behavior, competing nascent norms coexist, and slowly a new potential norm rises above its rivals. It has no constituency, merely potential to become the new defining behavior for the new circumstance. Over time it develops a following and an advocacy group—and it grows.

After emergence is the norm cascade. When the norm reaches viability, it begins to become more and more accepted, with the increasing speed of acceptability creating a cascade effect that broadens and accelerates acceptance. During this stage, the river becomes a figurative rapids, a cataract, and finally a waterfall. The cascade can involve either masses of insignificant players or a handful of major movers.

Once the norm is widely acknowledged, comes the third stage—norm internalization. At this point, a norm can still die because it requires near-unanimous acceptance and compliance. The norm is not theoretical but integral to whichever condition it deals with. Internalization commonly does not occur unless it is to the real advantage of major powers.

Norm theory works for the sciences, soft and hard, but as Mazanec acknowledges, it requires significant refinement and narrowing to fit the evolution of weapons technology. In narrowing the theory to fit, the author discards the positive and voluntary aspects of the theory, throws out peaceful or positive norms, and focuses on the proscriptive ones that define power relationships in the creation of weapons use and development norms. Mazanec notes that he deals with restraints rather than permissions.

Among the norms he addresses is the set for cyber war, but the study takes a long time getting there. Before attempting to discuss cyber war norms, the author applies norm theory to other weapons technologies that arose in the previous 125 years or so. Examples of the development of norms for emerging weapons technology include gas, airpower, nuclear weapons, contemporary emerging technologies, and, finally, cyber warfare.

First, Mazanec recaptures the history of chemical and biological weapons development— the events leading to the international consensus that such weapons were unacceptable. He notes, among other things, that the weapons-ban norm arose from preexisting norms that outlawed some other sorts of behavior as barbaric and that for the most part, the norm has stood despite pressure for many decades, with only rogues violating the norm—the Iraqis under Saddam Hussein, for instance.

Mazanec also cites strategic bombing. In this case, the norm began developing even before such bombing became possible. It failed to become internalized because bombing be-

came advantageous to one power rather than to all, and the advantage overwhelmed the potential barbarism of the technology. The author's key argument is that a norm will not internalize if a power finds advantage in rejecting it or imposing it on others while remaining aloof.

Nuclear and emerging-technology weapons are the other scenarios, the former much more developed than the latter. And the final emerging technology, late in this work, is cyber warfare. At this point, Mazanec seemingly throws up his hands, noting that the major powers have no incentive, are active players against cyber foes, and probably could not do much other than what they do. He develops no scenario in which a norm for cyber warfare can become internalized. Even cascading is unlikely.

Norms must go through all of the stages if they are to mature and become internalized. Nothing in the theory says that a norm will do so, though, and the author does indicate that some norms stall out at one level or another because of factors that he describes—the most important being the disincentive for those in power to accept the norms and their restraints. Mazanec reads this disincentive as dooming the development of any effective norm for or against cyber war.

The Evolution of Cyber Warfare includes a list of abbreviations, notes, and a bibliography, as well as an appendix that expands on the events summarized or referenced in the short chapter on cyber warfare. For chemical/biological weapons, strategic bombing, and nuclear arms, the author incorporates this sort of material in the relevant chapter. Segregating it in an appendix for cyber war seems odd, given the tendency of the casual reader to ignore end matter generally, but the appendix is useful nevertheless.

The first impression after finishing the study is that the author spends too much time developing norm theory and too little applying it to cyber warfare. The imbalance is one negative, and another is the finding that norm theory does not allow significant prediction of how cyber warfare will develop.

The book is either irrelevant or premature if all it can offer is a recommendation to mobilize and prepare to withstand the onslaught—old stuff because norms will not develop to restrain bad actors from engaging in cyber warfare. In sum, Mazanec says to stay the course and throw out any prospect of norms arising to regulate cyber warfare. In short, although the author has developed an interesting study of norm theory as it pertains to what is acceptable and unacceptable in the development and use of weaponry, he fails to show that norm theory is all that useful in the specific area of concern—cyber war.

If the ultimate outcome of his study is that norm theory indicates that norms will not develop for cyber warfare, then what is the point? It is a provocative test of a social science theory, but the result of the experiment is failure in the applicable case. Readers looking for some sort of idea of where cyber warfare countermeasures might trend in the short or long term will find no guidance here. For the practical warrior, *The Evolution of Cyber Warfare* does nothing.

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Infinity Beckoned: Adventuring through the Inner Solar System, 1969–1989 by Jay
   Gallentine. University of Nebraska Press (http://nebraskapress.unl.edu), 1111 Lincoln
   Mall, Lincoln, Nebraska 68588-0630, 2016, 496 pages, $36.95 (hardcover),
   ISBN 978-0-8032-3446-8.

At the end of *Infinity Beckoned*, an engaging and informative work of narrative space his-
tory, historian and filmmaker Jay Gallentine provides the following description:

> But a select few—unconsciously responding to the soft patter of a rhythm they couldn't quite
> place—seemed more engaged, more responsive. They wrote nineteen paragraphs instead of four,
> troweling up deep layers of facts nobody else heard of. They got branded Teacher's Pet or kooky, or
> both. Really, they just *had* to know more. Even after the unit ended they got an extra book about
> planets from the library. They asked to look through a telescope. They wanted to go to a planetar-
> ium or to a geology exhibit and touch a meteorite. They sketched hypothetical spacecraft of their
> own. They asked *how* do we know, *when* did we learn, *why* is it like that? Maybe one of these people
> was you (emphasis added, p. 454).

Such people are the intended audience of this lengthy but compelling story of the mostly
unmanned exploration of the inner solar system, including missions to Mars (Viking), the
Moon (Luna, Lunokhod), Venus (Venera), and Halley's Comet (Vega), among others.

The attention the author pays to details and to engaging stories makes this work a com-
pelling narrative history. He tells of the stress and grind of working with the American and
Russian space bureaucracies and of the marital strain that results from spending so much
time away from home: trips to remote laboratories and secretive facilities where one is under
the stress of international competition and the immense constraints of dealing with space
exploration—high costs, intense scrutiny, wish lists of cosmic proportions, and extreme en-
vironmental demands for performance under heinous conditions. Gallentine does not
mince words about the temperature swings of the moon and Mars, of gravitational anoma-
lies, of the difficulties of demonstrating a case of life on Mars and differentiating it from
chemical processes, and of the thrill of being the first to reach and to explore alien worlds,
even remotely. The details of the stories—the difficulty of resigning from jobs one does not
want, the stress and strain on families, the arguments between scientists—provide a
grounded reality to dreams people often have about space and space exploration.

The author does not so much seek to prove a point as tell an interconnected series of sto-
ries about mostly Russians and Americans although he includes a French balloon enthusiast
who still explores space into his nineties. He does so through 28 chapters buttressed by
more than 50 photographs, some of which show aspects of the Soviet space program largely
unknown to Western audiences. In telling a story, the author often lets others tell their own,
in their own words as much as possible. Gallentine presents Gil Levin, eccentric scientist
and passionate proponent of the existence of life on Mars of the kind that lives in Antarc-
tica, and his driven, capable assistant Pat Straat, as enthusiastic about horses as about outer
space. In other chapters, he sympathetically lets Roald Sagdeev express his own deep am-
bivalence about his job, reflect on the collapse of his first marriage, or rejoice in his second
marriage and departure from post-Soviet Russia. There is Soviet obfuscation, the drama over
how to get a privileged direct phone on one's desk, and the way the Soviets used openly ac-
cessible American data to help their own space missions. The skill of the writer and the pas-
sion of the people he discusses, based upon his interviews and archival research, blend to
make this book a compelling history of unmanned spaceflight within the inner solar system,
defined as the area between the asteroid belt and the sun.

Although *Infinity Beckoned* is a fine historical work, it is perhaps even better as the ex-
pression of hope shared by the author and most of the people he speaks about in the further

expansion of knowledge and familiarity. Gallentine does not precisely seek the colonizing or terraforming of other realms, but one clearly senses frustration at the lack of progress over the past 25 years in missions of space exploration in our closest neighborhood of the solar system. By giving full voice to the hopes and efforts of past scientists and explorers, the author encourages the reader to dream of encouraging and cheering on—or even participating in—similar efforts in the future despite living in an age of budgetary austerity where a vision of answering deep, important questions about the existence of life on other worlds, or understanding conditions on those planets, has been sidetracked into the incremental hunt for water on Mars or other fairly small-scale tasks. This ambitious work encourages determination in people who hunger and thirst for the exploration of outer space. As a postmortem on a glorious age of solar system exploration that encourages the glory days ahead, it manages both to inform and excite us.

Nathan Albright
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The Case for U.S. Nuclear Weapons in the 21st Century by Brad Roberts. Stanford University Press (http://www.sup.org), 425 Broadway Street, Redwood City, California 94063-3126, 2015, 352 pages, $24.95 (softcover), ISBN 978-0-8047-9713-9.

Need a break from the standard global zero talking points? You'll find a new approach to that topic in Brad Roberts's *The Case for U.S. Nuclear Weapons in the 21st Century*. You won't find anything in the way of the history of the atom. Nor does the author devote much space to the history of the Cold War. Instead, this book gives you a fast-moving, highly readable, and in-depth look at the modern challenges to sound nuclear policy while ultimately offering a realistic answer to the question, Do nuclear weapons "make an important and irreplaceable contribution to the national security of the United States" (p. 1)? Roberts answers with a resounding "Yes!"

Dr. Brad Roberts established himself as a nuclear policy expert not only through his academic acumen but also as a policy expert in Washington. Most recently, he served in the Obama administration as deputy assistant secretary of defense for nuclear and missile defense policy. Are you familiar with the 2010 *Nuclear Posture Review Report*? He helped write it. Couple that with his work on the 2010 *Ballistic Missile Defense Review Report* and the image of a nuclear policy authority begins to emerge. So what does this authority have to say concerning nuclear weapons in the twenty-first century?

Overwhelmingly, he advocates for the retention of US nuclear capability. While keeping open the possibility of unilateral nuclear arms reductions and even acknowledging the elimination of nuclear weapons as a worthy goal, Roberts explains that current and emerging threats prevent such actions. He focuses most of his analysis on the three "Red" powers of a resurgent Russia, an emerging China, and an increasingly hostile North Korea. Roberts's breakdown of North Korean motivations and actions should prove particularly interesting to readers of the *Air and Space Power Journal*, as will his recommended counteractions. Through this analysis, he concludes that possession of nuclear weapons remains a critical component in the US policy-making arsenal.

How then should the United States deal with the remainder of the world's nuclear powers or the emerging regional players? Herein lies one of the few weaknesses of this book. Although he does a more than adequate job addressing many aspects of modern proliferation, Dr. Roberts misses the opportunity to take his audience further into the nuclear policy quandary that is Iran. Granted, the recent (2015) *Joint Comprehensive Plan of Action* resolves immediate concerns, but a book dedicated to providing recommendations for twenty-first-

century problems should delve deeper into the myriad of possible outcomes of a nuclear Iran and the possibility of additional proliferation throughout the Middle East.

Despite this oversight, Roberts's effort more than deserves to be read by people seeking to understand the modern nuclear policy environment. Those who pick it up will quickly find themselves thinking beyond the semantics and theories of the Cold War and thrust into the intricacies of modern nuclear reasoning. Individuals staunchly in the global zero camp should read this book with the recognition that Roberts shares their ideals but noting that through his analysis, he is forced to conclude the following: "For now, we must cope with the reality we face" (p. 240). In doing so, *The Case for U.S. Nuclear Weapons in the 21st Century* confirms that the United States needs nuclear weapons in the twenty-first century—at least for now.

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Air Warfare: History, Theory and Practice by Peter Gray. Bloomsbury Publishing (http://www.bloomsbury.com), 1385 Broadway, 5th Floor, New York, New York 10018, 2015, 208 pages, $29.95 (softcover), ISBN 978-1780936628.

In *Air Warfare: History, Theory and Practice*, Peter Gray, a senior researcher in airpower studies at the University of Birmingham, gives readers a comprehensive look into the complex world of airpower and the history that paved the way for its mainstream use in today's conflicts. The overall perspectives throughout the textbook are United Kingdom (UK) centered and do not include documentation from non-UK sources. The extensive use of references throughout offers readers clues as to where more information on the topic can be found. Consisting of nine chapters, *Air Warfare* provides students at all levels a supporting textbook to accompany their courses and/or research interests.

Gray's broad look at air warfare and its history generates different perspectives on airpower, supported by extensive documentation. Following the introduction in chapter 1, chapter 2, "Air Warfare, War Studies and Military History in the Twenty-First Century," and chapter 3, "Air Warfare Historiography and Sources," serve as a blueprint for how a student and/or researcher should go about constructing a sound air warfare historiography. The author makes valid points, and most of his arguments are eloquently expressed. In these early chapters, he addresses flawed scholastic studies from which students and researchers frequently draw conclusions. He attributes this tendency to (1) the misperception that military history is only glossy publications, color schemes of weapon systems, elite uniforms, and detailed accounts of tiny battles outside the greater campaign; (2) some authors' practice of merely listing the battle and lives of dead generals; and (3) a distaste for the politics of a particular conflict (pp. 6–8). To ignite discussion and critical thinking, Gray alludes to opposing views to both support and dispute his points.

Chapter 3, mentioned above, examines historiographical sources on the topic of airpower, noting the influence of formal doctrine on the Royal Air Force (RAF) / Royal Navy mind-set and on early agencies. Gray points out that RAF doctrinal publications sat dormant from 1968 until 1990, when the 4th edition of Air Publication (AP) 1300, *Royal Air Force War Manual*, reemerged (p. 19). The *UK Strategic Defense Review* of 1997; the 3rd edition of AP 3000, *British Air Power Doctrine*; and BR 1806, *British Maritime Doctrine*, followed as the British military focused on updating doctrinal publications (p. 19). The author uses case studies after each chapter to drive home its main points, thus giving readers the opportunity to see Gray's perspectives and arguments in a different light and opening avenues for discussion.

Chapter 4, "Airpower Thinking and Theory," points out alternative paths in the development of airpower thinking (p. 37). The author does not limit his coverage to the airpower prophets but encompasses expansive thinking on air warfare. He does, however, refer to the prophets' publications on the topic throughout the chapter.

"Air Warfare in Practice," the fifth chapter, covers the origins of particular roles in air warfare and describes the development of airpower thinking. Subtopics include aerial reconnaissance, naval aviation, control of the air, air-land support, strategic airpower, and generic issues. The author's views are all doctrinally based and supported by examples from past conflicts. However, Gray does ponder the cost and operational effectiveness of airpower in practice, offering references for students to explore the strategic air offensive and its effects on the enemy's diplomacy, morale, internal security, and economical infrastructure (p. 64). The author identifies the ownership of strategic air assets as another issue commonly fought over before and during most air campaigns. His solution is to have a flexible system, such as the one used in the Western Desert. Additionally, a nation's prioritization of airpower is ultimately decided by governmental bureaucracy.

In chapter 6, "Leadership and Command of Air Warfare," Gray argues that the transition from tactical to strategic airpower is more condensed than that for any other form of warfare. He asks whether leadership in the air is the same as that on the ground and whether it applies across all levels of command. After establishing a baseline definition of leadership, derived from publications of the Defense Leadership and Management Center, Gray outlines the different problems associated with operational and strategic environments. He then concludes that the two environments have different decision-making dynamics that may require varying leadership styles. Reflecting on the annual Christmas address of the UK chief of defense staff to the Royal United Services Institute in 2009, Gray suggests that the problem lies with the education, selection, and employment of strategic thinkers (p. 71). Amplifying the problem is the strategic leader's ability to adapt his or her approach to both peacetime and wartime operations.

In terms of command and control of airpower, the author stresses that command must be retained at the highest level to ensure unity of effort. The concept of centralized control / decentralized execution has been well documented and remains the cornerstone for the command and employment of US airpower. Gray's viewpoint regarding the origins of air warfare's legality, legitimacy, and ethics becomes clear in chapter 7, which examines those topics. The author also notes that Dr. Francis Lieber's efforts to codify the rules of warfare marked the first significant attempt to bring air warfare to the forefront of international law. Ultimately, Dr. Lieber's inputs were later adopted by the Geneva Convention during development of its protocols and articles. Chapter 8, "Air Warfare Strategy, Operations and Tactics," simply reviews the levels of warfare and analyzes airpower. The "Concluding Comments" of chapter 9 end the book.

Broadly speaking, Gray has written an informative history textbook for the novice student of air warfare—one that is well worth reading. It is filled with references intended to broaden students' perspectives on the subject. Readers, however, could have benefited from exposure to the full spectrum of air warfare had the author addressed how the battle in space is changing all aspects of airpower. Instead, Gray merely touches on the issues associated with remotely piloted vehicles and the ethics of their employment and on how satellite and near-real-time intelligence affects decision making at the strategic level. Ideally, *Air Warfare* should look more extensively into space warfare as a means of helping readers fully understand today's fight and identify a way forward into tomorrow's battlespace.

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The Three Musketeers of the Army Air Forces: From Hitler's Fortress Europa to Hiroshima and Nagasaki by Robert O. Harder. Naval Institute Press (http://www.usni .org/navalinstitutepress), 291 Wood Road, Annapolis, Maryland 21402, 2015, 288 pages, $39.95 (hardcover), ISBN 978-1-61251-902-9.

Robert Harder's *The Three Musketeers of the Army Air Forces* offers an intriguing look into the lives and background of the pilot (Paul Tibbets), the bombardier (Tom Ferebee), and the navigator (Ted "Dutch" Van Kirk) who flew the *Enola Gay* on 6 August 1945 and conducted the first combat employment of a nuclear weapon. The book follows the three men from childhood to life after the war as they made their way and left their mark on history.

What drew me to this book was the inclusion of the bombardier and navigator, as well as the pilot, and their participation in what would arguably become the most famous combat mission ever flown. The author does a fantastic job of presenting the life story and military career of each of the three men and the aftermath of their historic mission. By looking at their entire lives, readers can get a good picture of who these men were and the events that shaped their careers.

This book effectively tells the story not only of the men but also of their creation of the world's first nuclear bomber unit without really knowing what they were doing or why. Formation of this new unit was known to be significant, but readers quickly grasp that none of the crew members knew that their lives would change in such dramatic fashion. In an instant, they are transformed from simply another well-trained combat bomber crew to the focal point of international politics and debate for the rest of their lives.

I do have a small quibble with the book—specifically, the lack of criticism. Harder alludes to the point that the crew on *Bockscar*, the aircraft that dropped a second atomic bomb on Nagasaki, might not have been the best available, yet they were allowed to fly the mission. In the appendix (which tells the story of the second mission), he mentions the animosity that Tibbets had towards that mission's failures, but I felt that Harder was a little too kind to him. If Tibbets thought the problems were caused by a lackluster crew, then he should have shouldered more, if not all, of the responsibility since he picked them. Additionally, Harder mentions a perception of favoritism in the unit but never really offers a good explanation. In this regard, I wish the author had provided a bit more criticism of the situation.

Overall *The Three Musketeers of the Army Air Forces* is a wonderful book to read for a look into the lives of the men who flew into history on that fateful day. By presenting a narrative of the crew members' entire lives, Harder helps the reader identify with the men on a more personal level. Furthermore, this technique reveals how the crew handled the pressure, thus letting the reader walk away with an appreciation for what they really did. At the end of the day, this book is a great read for anyone who wants to get a better picture of the individuals who flew those fateful missions and of how they created the world's first nuclear combat unit.

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Imperial Russian Air Force, 1898–1917 by Gennady Petrov. Unicorn Press (http://www.unicornpress.org), 101 Wardour Street, London, W1F 0UG, 2013, 263 pages, $36.44 (softcover), ISBN 978-1-90650-940-8.

As the subtitle on the inner title page indicates, *Imperial Russian Air Force, 1898–1917* is, first and foremost, a history in photographs. The 17 pages of text, although double columned, are interspersed throughout 259 pages of pictures. The book is divided into seven chapters, each covering a specific theme, including early balloon flight as well as World War I Russian aces. Each chapter begins with not only one to three pages of introduction that offer a brief history of the theme but also several pages of related pictures.

The failure of this book, however, is that the author, Gennady Petrov, attempts to crowd too much detail into these meager introductory pages and refers to over 300 names, most of which only the most dedicated historian of Russian aviation will recognize. For less knowledgeable readers, the names are left floating meaninglessly in the multiple lists of "important" figures in Russian aviation that the author includes throughout the book.

In the limited text, many subjects that could take up chapters by themselves are covered in one paragraph. Moreover, if the reader wishes to delve further into any particular event, he or she is out of luck because Petrov offers no bibliography. Even direct quotations go unreferenced.

Since the history of powered flight paralleled the Russian empire by only a little less than two decades, most of the pictures cover the time between 1910 and 1915. The images vary in quality, and the captions supply minimal details. Most of the pictures, many of them posed, consist of various individuals standing by different designs of powered aircraft. Unless readers are familiar with the litany of names posted in the captions, those individuals will remain mere curiosities with little historical value. However, the aircraft design enthusiast may find the pictures interesting because the book depicts multiple configurations throughout.

Although Petrov's primary purpose is to compile a photo history of early Russian aviation, he does propose the theory that had the empire survived, its air arm could have surpassed that of other developing nations in both design and capability. Unfortunately, although the author lists several firsts and makes bold proclamations regarding the influence of early Russian aviation design, he presents little evidence to support his claims, leaving the reader with only a few statements and pictures (p. 193).

The text, although limited, does offer a solid historical timeline of early Russian aviation. However, without sources or references, the book has little research value. As a history in pictures, this volume is also limited. As is typical of the time, the photos are grainy, and many are too dark to discern details. However, the saving grace of the *Imperial Russian Air Force* is that it does provide considerable photo evidence in a compact package. For the informed, the images complement the many historical tomes written about Russian aviation. Furthermore, for the novice historian, it delivers a cornucopia of lists regarding early Russian aviation that afford a good starting point for further research.

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P-51 Mustang: Seventy-Five Years of America's Most Famous Warbird by Cory Graff. Zenith Press (http://www. http://www.quartoknows.com/Zenith-Press), 400 First Avenue North, Suite 400, Minneapolis, Minnesota 55401, 2015, 224 pages, $40.00 (hardcover), ISBN 9780760348598.

When readers think of World War II fighter aircraft, the P-51 Mustang is often the first one that comes to mind. In 2015 the P-51 celebrated the 75th anniversary of its first flight. Cory Graff's *P-51 Mustang: Seventy-Five Years of America's Most Famous Warbird* is a wonderful celebration of this aircraft's illustrious history.

The iconic P-51 was born from Britain's desperate need for more platforms to fight the German Luftwaffe. When the British Purchasing Commission approached North American Aviation about manufacturing the P-40 under license, that company's leader, "Dutch" Kindelberger, responded that North American could make a better aircraft faster than it could begin production of the P-40. Equipped with an Allison engine, the initial P-51 proved a bit anemic in performance, but when mated with the Rolls Royce Merlin engine, it became one of the Allies' most capable—if not *the* most capable—and versatile aircraft: the lead horse in the American fighter stable.

As the long-range escort for American bombers on missions across the European continent, the P-51 played an essential part in winning the air war there. The Mustang proved its versatility by serving not only as an escort but also as a reconnaissance and ground-attack aircraft. Further, it performed admirably in the Pacific theater, continued to serve as a dedicated ground-attack platform in the Korean War, and, after retiring from military service, became a prized icon among civilian warbird owners as well as air racers.

To tell the story of the P-51, Cory Graff has pulled out all the stops, combining detailed yet easy-to-read text with a multitude of photographs and period advertisements to bring the tale to life. The book is a 60-40 split between images (photographs, drawings, and period advertisements) and text, respectively. Throughout, the author includes two-page vignettes of the Mustang and the men who flew her, such as the Tuskegee Airmen.

Although most readers interested in the P-51 have probably seen countless numbers of photos of the plane, Graff seems to have uncovered a heretofore unknown treasure trove of seldom-seen, well-captioned images. Particularly interesting are all of the many period P-51 advertisements. Rather than confine himself to historical photographs, Graff also includes images (mostly air-to-air) of today's surviving P-51s.

Although researchers would find a list of his sources useful, Graff's purpose is to tell the story of the P-51 in an enjoyable fashion, utilizing broad history, focused vignettes, and a wonderfully robust collection of photographs and images. Printed on thick, high-quality paper, *P-51 Mustang: Seventy-Five Years of America's Most Famous Warbird* is best described as a "meaty" coffee-table book for fans of both this aircraft and other World War II warbirds. This book will easily earn a prime spot on readers' shelves or coffee tables.

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